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Patterns of bryophyte diversity and rarity in the Okanogan Highlands of Washington State

by

Erica Rea Heinlen ©

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of the requirements for the degree of Master of Science

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Abstract

Increasing awareness of the importance of bryophytes in ecosystems has heightened conservation efforts for them. Understanding the factors that influence patterns of richness and rarity in bryophytes thus is both valuable and timely in developing conservation strategies. In order to decipher these patterns, I sampled 141 sites from a variable landscape in the Okanogan Highlands of Washington State and subjected the resulting data to a number of different analyses. Bryophytes did show patterns of occurrence on the landscape with respect to richness and rarity for a number of different environmental descriptors. In particular, the bryophyte flora is richer in fens and streams and has more rare species in fens, streams and cliffs than in other mesohabitat (landform) classes. Mesohabitats, thus emerge as an appropriate level for a coarse filter approach to prioritizing conservation efforts for bryophytes in the study area.

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Chapter 1.
Introduction

Biodiversity has become the buzzword of recent conservation efforts. The terms biodiversity and diversity have a long history and have been subjected to a plethora of interpretations (Peet 1974). In its most general sense, biodiversity means 'variety of life forms' (Burton et al. 1992). This variety of life allows ecosystems to remain productive and stable during periods of environmental stress (Burton et al. 1992). In most cases, researchers do not fully know or understand the processes and contributions of species, thus the loss of diversity may have an unpredictable, cascading effect on ecosystems (Burton et al. 1992). Conservation for the variety of life provides protection for organisms that could produce scientific, medical, economic or social benefits in the future (Burton et al. 1992). Others strive to preserve diversity based simply on conviction about the intrinsic value of all species (Söderström et al. 1992).

For purposes of this study, biodiversity relates to species richness or the number of species in a site. Peet (1974) supported species counts as a practical and objective method of measurement of diversity. Some ecologists include the evenness, or degree of dominance, of species in their biodiversity studies (Burton et al. 1992; Whittaker 1972), however this tends to de-emphasize the importance of rare taxa (Brown & Gibson 1983), and therefore will not be considered here. Diversity measurements can occur at many scales. In this study, diversity will be evaluated at the site level (alpha diversity) and at the landscape level (gamma diversity) by Whittaker's (1972) definitions.

The term rare conveys just as many or more meanings than the term biodiversity. The meaning of rarity also largely depends on the scale of the analysis. To some, "rare species" may only include those that show global decline and to others they may be listed as endangered, threatened or sensitive on a regional level. Still others consider rare species to be those that occur infrequently on a local landscape. The majority of species on a landscape occur infrequently (Drury 1974; Newmaster 2000; Vitt 1991; Vitt & Belland 1995, 1997), thus local rarity is common. In my thesis, the term "rare" will refer to those species that occur infrequently in the study area.

Conservation efforts for these locally rare species will automatically encompass many concerns about rarity at regional, national and global scales.

Many causes of rarity exist. Some species naturally occur as rare based on small geographic ranges, narrow habitat specificity and small local population size (Rabinowitz 1981). Species may be under stress from natural processes, like climate change, over long periods of time (Rabinowitz 1981). A growing number of species, however, are rare because of human disturbances such as habitat destruction (Koponen 1992; Slack 1992; Thomas & Raphael 1993). For understudied organisms like bryophytes, rarity may also be related to lack of basic distributional data as a result of minimal collection by bryologists (Slack 1992).

While conservationists have long considered vascular plants in their efforts, lower organisms like bryophytes have not aroused much attention (Hedderson 1992; Slack 1992; Vitt 1991). Recent studies have found increasing evidence for the importance of bryophytes in ecosystems. Vitt (1991) and Longton (1984) state that bryophytes contribute to their surroundings through energy flow, nutrient cycling, primary bio-production and water relations. Bryophytes also interact with other plants and animals (Davidson et al. 1990; During & van Tooren 1990; Longton 1984) and act as colonizers in primary succession and help to stabilize soil (Longton 1984, 1992; Slack 1988). Bryophytes also show high microhabitat specificity (Hedderson & Brassard 1990; Slack 1992; Söderström 1993), which makes them useful as indicators (Vitt & Belland 1995).

The high microhabitat specificity of bryophytes may also make them vulnerable to habitat change from natural or human caused disturbances. Researchers have begun to study the effects of wild and prescribed fire (de las Heras-Ibáñez et al. 1991; Gorshkov & Bakkal 1996; Johnston & Elliott 1996), livestock activity (McIntosh 1986) and past logging events (Gustafsson & Hallingbäck 1988; Jalonen & Vanha-Majamaa 2001; Lesica et al. 1991; Newmaster & Bell 2002; Rambo & Muir 1998) on bryophyte communities.

With increased awareness of the importance of bryophytes in ecosystems as well as their potential vulnerability, researchers are trying to increase the conservation efforts for them. Factors including the inherent difficulty of identifying them (Hedderson

1992) and the lack of occurrence and distribution data (Slack 1992; Söderström et al. 1992) currently inhibit development of well-defined conservation strategies. Attempts to find taxa with similar distributions in order to have "surrogates" for less well known taxa have fallen short, finding that different taxa do not overlap in their diversity "hotspots" (Dirkse & Martakis 1998; Pharo & Beattie 1997; Pharo et al. 1999; Prendergast et al. 1993).

The knowledge of bryophyte species in Washington State is in a rudimentary state. Currently, no published checklist of bryophytes species exists for the state. To date bryophyte exploration has been mostly restricted to the wetter forests west of the Cascade Mountain range (Christy & Harpel 1997). The drier regions of eastern Washington remain virtually overlooked bryologically (Christy & Harpel 1995, 1997; Harpel 2001).

Despite this rudimentary knowledge, conservation efforts for bryophyte species in Washington have begun. With the adoption of the Northwest Forest Plan (United States Department of Agriculture & United States Department of the Interior 1994) associated with the old-growth/spotted owl controversy, land managers in the Pacific Northwest became suddenly aware of these lower organisms with mandates to manage for them. Although these mandates affect only the wetter, coastal forests of Washington, Oregon and California, their influence has expanded much further. The Interior Columbia Basin Ecosystem Management Project (ICBEMP) began in 1994 to assess the ecosystems of the Columbia Basin, a 145 million acre area (United States Department of Agriculture, Forest Service & United States Department of the Interior, Bureau of Land Management 1996) that includes the present study area. Although still in the review stages, land managers in the ICBEMP study area expect management guidelines for all organisms, including bryophytes. Christy and Harpel (1997) compiled a preliminary list of rare bryophytes for the ICBEMP assessment area. Also, the Washington Natural Heritage Program, responsible for state lists of sensitive species, has compiled a "working list" of non-vascular plants (Washington Natural Heritage Program 1997) and the U. S. Forest Service has begun the process of evaluating which non-vascular taxa to include on its Region 6 (Washington and Oregon) sensitive species lists. The task of surveying and managing for bryophytes in eastern Washington looms in the near future.

Micro management for an individual species does not work efficiently without an adequate knowledge of the species itself, including its taxonomy, ecological and reproductive requirements (Söderström et al. 1992). Without this basic knowledge, Söderström et al. (1992) urge increased surveys and recognition of rare taxa, as well as protection of habitats in natural and man-made landscapes until more information warrants more selective efforts. They recognized that a coarse filter, or landscape level, approach to rare species management was needed.

Haufler et al. (1996) state that a coarse filter partitions the landscape based on ecological, biological, or operational similarities. Detecting patterns in bryophyte richness and rarity between different partitions of the landscape can offer guidance for prioritizing conservation in a coarse filter approach. Several methods for pattern detection exist. Comparison between different groups (e.g. rare species versus non-rare species) can reveal patterns as Vitt and Belland (1997) showed for rare moss species in Alberta. Multivariate ordination techniques can aid ecologists in detecting and evaluating species composition, with corresponding richness and rarity values, along environmental gradients (Doubt 2001; Heikkinen 1996; Lee & La Roi 1979; Rambo & Muir 1998). Further, analyses of different classes of a partitioned landscape (either by landform, forest type or community type), can reveal differences in richness and rarity values. Vitt and Belland (1997), for example, related rarity of mosses in Alberta to mesohabitats, or physiognomic forms (i.e. streams, cliffs, etc.) on the landscape. These techniques will be used to decipher the patterns of richness and rarity in the study area in order to provide land managers guidance for bryophyte conservation strategies.

Objectives

The objectives for this study are:

- To produce a list of bryophytes for the study area in order to provide needed distributional data for the region as well as provide a benchmark for future studies in the area;
- To detect patterns in bryophyte richness in the study area with regard to their

  - Relationship to environmental gradients,
  - Distribution among different partitions (landforms, forest type, etc.) of the landscape, and
  - Spatial distribution;
- To detect patterns in bryophyte rarity in the study area with regard to their
  - Relationship to environmental gradients,
  - Distribution among different partitions (landforms, forest type, etc.) of the landscape,
  - Spatial distribution,
  - Taxonomic and morphological affinities,
  - Habitat preferences, and
  - Ecological and geographic distributions
- To use the discovered patterns to provide suggestions to guide conservation efforts for bryophytes in the study area.

Definition of Terms

Biodiversity/Diversity	For purposes of this study, biodiversity means species richness.
Landscape patch	Landscape patch (Chapter 2) refers to a combination of a mesohabitat and a biophysical environment (defined in the study area section of Chapter 2). Examples include a stream in a warm-dry biophysical environment or a stream in a cold-mesic biophysical environment.
Mesohabitat	Mesohabitats are physiognomic or physiographic landforms in the landscape, for example streams, cliffs, upland forest, etc. as defined by Vitt and Belland (1997). Unrestricted mesohabitats include the upland matrix in which the restricted mesohabitats (which include fens, wetlands, streams, springs, cliffs and talus slopes in this study) are imbedded.
Microhabitat	Bryophytes inhabit substrates at a small, local scale. Microhabitats are features on which bryophyte individuals or colonies live. Examples include rocks, logs, trees, soil, etc.
Rarity/Rare species	For purposes of this study, rare species occur infrequently (one or two occurrences) in the study area.
Site	Sites in this study are equivalent to the mesohabitats. Contiguous areas of unspecified area within the mesohabitat were sampled until no more new species were encountered.

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Chapter 2.

Patterns of rarity in mosses of the Okanogan Highlands of Washington State: an emerging coarse filter approach to rare moss conservation.

(A version of this chapter has been submitted
to *The Bryologist* for publication.)

The term "rarity" invokes many different definitions and responses in modern scientific and management circles. To some "rare species" may only include those species that are listed by the federal government as endangered, threatened or sensitive, i.e., those that show global decline. Others consider "rare species" as those that occur at low abundance within a local area, even though they may have wide geographic ranges.

Many reasons exist for the conservation of species. The diversity of life, including rare species, allows ecosystems to remain productive and stable during periods of environmental stress (Burton et al. 1992). In most cases, researchers do not fully know or understand the processes and contributions of species, thus the loss of species may have an unpredictable, cascading effect on ecosystems (Burton et al. 1992). Some see potential medical, economic and social benefits that could be discovered (Burton et al. 1992). Others strive to preserve species due simply to conviction about the intrinsic value of all species (Söderström et al. 1992).

While conservationists have long considered vascular plants in their efforts, lower organisms like bryophytes have not aroused much attention (Hedderson 1992; Slack 1992; Vitt 1991a). Recent studies have found increasing evidence for the importance of bryophytes in ecosystems. Vitt (1991a) and Longton (1984) state that bryophytes contribute to their surroundings through energy flow, nutrient cycling, primary bio-production and water relations. Bryophytes also exhibit interactions with other plants and animals (Davidson et al. 1990; During & van Tooren 1990; Longton 1984) and act as colonizers in primary succession and help to stabilize soil (Longton 1984, 1992b; Slack 1988). Bryophytes also show high microhabitat specificity (Hedderson & Brassard 1990; Slack 1992; Söderström 1993), which makes them useful as indicators (Vitt & Belland 1995).

With growing awareness about the importance of bryophytes in ecosystems, researchers are trying to increase conservation efforts for them. Factors including the inherent difficulty of identifying them (Hedderson 1992) and the lack of occurrence and distribution data (Slack 1992; Söderström et al. 1992) currently inhibit development of well-defined conservation strategies. Attempts to find taxa with similar distributions in order to have "surrogates" for less well known taxa have fallen short, finding that different taxa do not overlap in their diversity hotspots (Dirkse & Martakis 1998; Pharo & Beattie 1997; Pharo et al. 1999; Prendergast et al. 1993).

Conservation efforts for bryophytes in Washington State have just recently begun. With the adoption of the Northwest Forest Plan (United States Department of Agriculture & United States Department of the Interior 1994), land managers west of the Cascade Mountains became suddenly aware of these organisms with mandates to manage for them. Other governmental studies, such as the Interior Columbia Basin Ecosystem Management Project, and the Washington Natural Heritage Program have proposed preliminary lists of rare mosses that affect the drier eastside of Washington State (Christy & Harpel 1997; Washington Natural Heritage Program 1997). Land managers face the daunting task of managing for these small organisms.

Micro management for an individual species does not work efficiently without an adequate knowledge of the species itself, including its taxonomy, ecological and reproductive requirements (Söderström et al. 1992). Without this basic knowledge, Söderström et al. (1992) urge increased surveys and recognition of rare taxa, as well as protection of habitats in natural and man-made landscapes until more information warrants more selective efforts. They recognized that a coarse filter, or landscape level, approach to rare species management was needed.

Understanding the factors that influence rarity in bryophytes thus becomes valuable in developing such coarse filter conservation strategies. Vitt and Belland (1997) provided a framework for studying the patterns of rarity in bryophytes in Alberta, Canada by comparing rare and non-rare taxa with regard to a number of taxonomic, morphological, ecological and geographical factors. The present study uses this framework to study the rarity of moss species in the Okanogan Highlands of Washington State. The objectives of this study are as follows:

1) To produce a benchmark list of moss species for the Okanogan Highlands area and to compare this list to what is known of bryophytes in the area,

2) To evaluate the moss species with regard to their frequency in the study area and characterize the moss species that are locally rare and

3) To provide recommendations to guide conservation strategies for mosses, including the basis for a coarse filter approach to rare moss conservation.

Study Area

The study area encompasses a large portion (1440 km^2) of Okanogan County in the Okanogan Highlands of north central Washington State. The United States-Canadian border forms the northern boundary and Washington State Highway 20 forms the southern border. The Okanogan River flows along the western border and the study area extends east to the Okanogan county line (Figure 2-1).

Physiography, geology and soils

The region ranges from 274m (900ft) in elevation in the valley to the top of Mt. Bonaparte at 2,213 m (7,260 ft). The topography has been highly influenced by the continental glaciation events of the Okanogan and San Poil Lobes of the Cordillean Ice Sheet (United States Department of Agriculture, Forest Service 1999). The advancement and retreat of these glaciers created the broad rounded mountains, foothills and valleys typical of the Okanogan Highlands area (United States Department of Agriculture, Forest Service 1998).

Metamorphic rock of old continental crust dominates the Okanogan Highlands region, with newer granitic rock intrusions. Volcanic rock outcrops occur in the northeast corner of the study area and a few limestone outcrops occur throughout the study area. The soils developed from the weathering of existing surface rock, from continental glaciation and from volcanic ash deposition following the retreat of the glaciers (United States Department of Agriculture, Forest Service 1999). Most soils contain a mixture of loam, sand and ash (United States Department of Agriculture, Forest Service 1999).

Climate

Dry conditions prevail as the study area lies largely in the rain shadow of the Cascade Mountains. Annual precipitation in the Okanogan River Valley averages 31.4 cm (12.35 inches) and increases eastward to approximately 76.2 cm (30 inches) in the higher elevations (Western Regional Climate Center 1999). Most of the precipitation occurs as winter snow and during a rainy season in May and June (McNab & Avers 1994). Minimum valley temperatures average 2.8°C (37.1°F) and maximum temperatures average 16.1°C (61°F) (Western Regional Climate Center 1999). Specific climate information is not available for the upper elevations of the study area, but the average annual temperatures decrease as elevation increases (Western Regional Climate Center 1999).

Vegetation and flora

The broad elevational gradient, the northerly latitude and dry, continental climate conditions provide for a large breadth of vegetation types within the study area. Lower elevations are dominated by semi-arid sagebrush steppe habitat, whereas the highest elevations experience sub-alpine conditions. The U.S. Forest Service has broken the landscape into categories based on temperature and moisture gradients. These biophysical environments (BE) are convenient ways to compartmentalize management decisions (Lowe 1995). Biophysical environments will be used to separate out forest types pertinent to this study. Descriptions of the biophysical environments come from McNab and Avers (1994), Lowe (1995) and Williams et al. (1990).

The riverine BE occurs along the Okanogan River in the valley at the west edge of the study area. Large *Populus trichocarpa* groves dominate the few uncultivated areas along the river. A contingent of shrubs including *Rosa* spp., *Rhus diversiloba*, *Cornus stolonifera* and *Salix* spp. dominate the sandy soils of these riverine habitats.

The non-forest BE occurs at the lowest elevations in the study area, up to approximately 1,220 m (4,000 ft) on some south-facing slopes. Native bunch grasses and forbs dominate the early successional stages, with intrusion and dominance of *Artemisia tridentata* and *Purshia tridentata* as time since disturbance increases. A large portion of the non-forest lands has been cultivated into orchards, livestock ranches and hay fields.

The lowest forests make up the hot-dry BE. *Pinus ponderosa* and *Pseudotsuga menziesii* occur as an open overstory to an understory of bunch grasses and mixed forbs.

The warm-dry BE occurs in slightly cooler, less exposed sites than the hot-dry BE. The soils tend to be shallower supporting a variety of different shrub species including *Symphoricarpus alba*, *Symphoricarpus oreophilus* and *Physocarpus malvaceus*, with dominant overstory trees including *Pinus ponderosa* and *Pseudotsuga menziesii.*

The cool-dry BE occurs a little higher in elevation but still on drier upland slopes. An overstory of *Pseudotsuga menziesii* with a carpet of *Calamagrostis rubescens* typifies this BE. Stands can include the tree species *Pinus ponderosa*, *Pseudotsuga menziesii*, *Larix occidentalis* and even *Abies lasiocarpa*, with and open park-like understory of *Calamagrostis rubescens*, *Arctostaphylos uva-ursi* and other forbs.

With the cooler temperatures and higher moisture conditions, the cool-mesic BE becomes prevalent. *Pseudotsuga menziesii* still dominates with other trees including *Pinus ponderosa*, *Larix occidentalis* and *Pinus contorta* occurring in the overstory. Shrubs species, e.g. *Vaccinium* spp., *Arctostaphylos uva-ursi*, *Amelanchier alnifolia* and *Linnaea borealis*, dominate the understory.

Very cold and wet sites make up the cold-mesic BE. *Abies lasiocarpa* dominates these environments with *Pseudotsuga menziesii*, *Larix occidentalis*, *Pinus contorta* and *Picea engelmannii* also occurring. Like the previous cool-mesic BE, a variety of shrubs dominates the understory.

The cold-dry BE occurs at the highest elevations, in cold-air pockets with relatively dry conditions. This BE most simulates the boreal forest, with thick stands of *Pinus contorta* with some intermixed *Abies lasiocarpa* trees. Understory vegetation is sparse with few *Vaccinium scoparium* shrubs and scattered grasses.

The top of Mt. Bonaparte fits into the sub-alpine BE. Cold temperatures, high snow pack and reduced growing season characterize this BE which is dominated by *Pinus albicaulis.*

The Okanogan Highlands contain a rich vascular flora, despite the relatively benign topography and homogenous substrates present. The Okanogan Highlands lie geographically on the edge of several different eco-regions that create a rich cross-section of vascular plants. The Okanogan Valley, which extends into southern British Columbia, creates a tongue of arid steppe habitat that extends from the Great Basin. Plants such as *Artemisia tridentata*, *Purshia tridentata*, and grasses like *Oryzopsis hymenoides* occur at their northern limits in the Okanogan Highlands area. Boreal species, e.g. *Cypripedium calceolus*, *Platanthera obtusata*, *Chrysosplenium tetrandrum*, reach their southern limits in northern Washington (Hitchcock & Cronquist 1973; Innes 1985). The Okanogan Highlands also lie between the Northern Cascade Mountains and the Rocky Mountains, and these eco-regions may also have their influence on the flora (Clausnitzer 1999).

Methods

Sampling

Recent bryophyte diversity studies have employed a floristic habitat sampling method, as opposed to plot sampling, to ensure the capture of all species, in all environments in the study area (e.g. Belland & Brassard 1988; Belland & Schofield 1994; Belland et al. 1992; Belland & Vitt 1995; Doubt 2001; McCune & Lesica 1992; Newmaster 2000). The floristic habitat sampling method encompasses sampling at several scales. Individual populations live in microhabitats (e.g. on logs, on rocks, on tree bases, Vitt & Belland 1997) and the variation in microhabitats influences the local diversity (Vitt et al. 1995). Microhabitats occur in non-random patterns on the landscape based on landform and structure (Vitt & Belland 1997). These non-random mesohabitats take the form of cliffs, streams, talus slopes, etc. These restricted habitats occur within a dominant forest type, or unrestricted mesohabitat.

I sampled at the mesohabitat scale, with the sites falling into one of the following seven mesohabitat classes: upland, stream, fen, cliff, talus, spring or wetland. Uplands refer to forested or non-forested slopes. Streams include the stream channel and stream bank within the influence (splash zone, high water line) of the water. Fens include all moss-dominated wetlands. Cliffs include vertical rock walls and associated ledges and talus slopes include boulder or rock fields with intermixed soil patches. Springs are areas of increased moisture within the upland matrix and may be with or without water flow. Wetlands are areas of seasonal or permanent wetness (ponds and wet meadows).

Sites occurred within one of the nine biophysical environments (forest types) described in the previous section. The BE for each site was defined by the upland (unrestricted mesohabitat) forest type. Within each site, I sampled all microhabitats present until no more species were found.

I wanted to identify all of the moss species within the study area and therefore I selected sites in as many different environments as possible. I selected sites based on my previous knowledge of the area, information from other biologists and residents in the area, as well as from studying maps and aerial photos. I tried to choose unique landforms, areas of high vascular plant diversity as well as sites typical within the landscape.

Unknown moss species were collected and identified in the laboratory. I generally followed the species concepts of Lawton (1971), but also referenced Crum and Anderson (1981), Flowers (1973), Nyholm (1975), Spence (1988), Zander (1981, 1994, 1998), Hofmann (1998), Koponen (1974), Shaw (1982), Blom (1998) and Mishler (1994). Species nomenclature follows Anderson et al. (1990) except for species as indicated in Table 2-1. Voucher specimens are deposited at the Devonian Botanic Garden Herbarium (ALTA-DBG) and at the University of Washington Herbarium (WTU).

Analysis

I produced species lists for each of the sites, from which I calculated the number of species occurrences within the study area. Many approaches to determining "rare" species exist. Several studies of larger land areas have used the cutoff of five locations or less for their designation of rare species (Christy & Harpel 1997; Vitt & Belland 1997; Washington Natural Heritage Program 1997). These criteria do not work well in the present, smaller study area, as it would designate more than half of the species as rare. Other studies have used published lists to designate their rare species. Longton (1992a) for example used a published list of rare mosses for Britain. This approach also falls short because the few published lists for the study area are incomplete and unverified (Christy & Harpel 1997; Washington Natural Heritage Program 1997).

Therefore, in order to explore the patterns of rarity in this study, I decided to arbitrarily break the species into three roughly equal frequency groups based on the number of occurrences. Rare species (N=68) occurred in 1 or 2 sites. Frequent species (N=71) occurred in 3 to 12 sites and common species (N=70) occurred in 13 or more sites. Discerning patterns for the locally rare species will provide information for conservation efforts at the local scale. Preservation of species at the local scale will ensure that the species will continue to exist also at regional or national scales.

I compared the moss species of the study area in the three frequency category groups (rare, frequent and common) to known lists from the area. The Washington species list, compiled by Judy Harpel of the U. S. Forest Service (Harpel 2002), is a working list based on literature and herbarium records for the state. The records are not complete and have not been verified, however, no other complete list of Washington mosses exists. John Christy and Judy Harpel compiled a list of bryophytes for the Interior Columbia Basin Ecosystem Management Project (ICBEMP) that covers areas east of the Cascade Mountains and west of the Rocky Mountains in portions of Washington, Oregon, Montana, Wyoming, Utah, Nevada and all of Idaho. This list was based on literature records and unverified herbarium specimens. I have compiled the list of mosses in their database (Christy & Harpel 2002) with a published list of rare mosses for the ICBEMP study area (Christy & Harpel 1997). Also in 1997, the Washington Natural Heritage Program produced a working list of rare mosses for the state of Washington. This was a preliminary list for the state, again based on literature and unverified herbarium specimens (Washington Natural Heritage Program 1997).

Mesohabitat and biophysical environments were assigned to each site in the field. The combination of these two factors then became a "landscape patch". I calculated the available patches occupied by taking the number of occurrences of each species in each landscape patch and dividing by the sum of those landscape patches that were sampled. I ran a one-way ANOVA (SPSS Inc. 2001) on the lognormal values of the percentage occupied for the three species frequency groups. I calculated the number of patches occupied for each species by simply summing the landscape patches in which each species occurred. I ran a Kruskal-Wallis (SPSS Inc. 2001) test (data skewed right with unequal variances) between the frequency groups. I used a non-parametric multiple comparison with unequal sample sizes to compare the groups (Zar 1999).

In each site I recorded the number of microhabitats occupied by moss (a set list of 72 microhabitats listed in Appendix A). I compared the mean number of microhabitats for sites that had rare species in them against sites that did not have any rare species in them by using a two-tailed t-test (SPSS Inc. 2001).

I assigned one of five substrate types (soil, rock, peat, water or wood) to each of the rare species based on its occurrence in the study area. These substrate types were used to assess relative importance of substrate types for rare species in the study area.

Lineage, growth form, phytogeographic affinity and world distribution information came from a database managed by René Belland (2002) for Canadian mosses. Vitt (1984) recognized the different moss lineages (ten represented in the study area). These lineages of mosses tend to occur in different large-scale environments (e.g. Bryales are characteristic of mesic, forested areas) and can therefore be useful in showing patterns. Growth form refers to the sexual condition of the moss. Acrocarpous mosses produce a sporophyte at the end of a stem or main branch, whereas pleurocarpous mosses produce sporophytes laterally (Crum and Anderson 1981). Phytogeographic affinity refers to the bioclimatic zone into which the majority of a species' world distribution falls (Belland 1987). Boreal species occur in northern latitudes, whereas temperate species occur in more southern latitudes. Montane species occur in mountainous regions and arctic-alpine species occur in extreme artic or alpine environments. Cosmopolitan species can occur in many areas and are not restricted to bioclimatic zone. The world distribution tracks species distributions longitudinally in the northern hemisphere, with continuous species occurring without interruption, disjunct species showing some interruption in their range, and the other categories occurring in narrower areas within the northern hemisphere (Belland & Schofield 1994).

Ten moss species not found in the database were placed into the appropriate categories based on current distribution information from the following sources: Lawton (1971) and Christy and Harpel (1997) for *Brachythecium bolanderi*; Lawton (1971) *for Racomitrium brevipes, Schistidium atrichum, Tortula bartramii*; Muñoz (1998b) for

Grimmia reflexidens; Vitt (1991b) for *Orthotrichum holzingeri*; Lawton (1971) and Crum and Anderson (1955) for *Physcomitrium washingtoniense*; Hedenäs (2000) for *Sanionia symmetrica*; and Blom (1998) for *Schistidium flaccidum* and *S. strictum*.

Species fit distinctly into the classes of these variables, which allowed for chi-square goodness of fit testing for the species frequency groups within each class. I used the following chi-square equation:

$$X^2 = \sum_{i}^{N} \left((O_i - E_i)^2 / E_i \right)$$

Where O_i is the observed number in one class and E_i is the expected number in one class (Zar 1999). Since the three species frequency groups represent equal groups of species, the expected value becomes one-third of the total number of species in each class. For example, if 60 species occur in the Bryales lineage, then one would expect that 20 of these would occur as rare, 20 as frequent and 20 as common in the study area. A significant result from the chi-square goodness of fit test means that one of the frequency groups occurs at a higher rate than would be expected from a random sample.

Results

Species list comparisons

Thirty-seven hundred field collections led to the identification of 209 moss species for the study area (Table 2-1). A plot of the species occurrences showed that many species occurred infrequently and few species occurred frequently (Figure 2-2). The left hand side of the curve shows that many species (42) occur in only one site, while the right hand side of the curve shows that few species occur in many sites (only 2 species occurred in over 100 sites). The creation of three frequency groups (rare, frequent and common) allows for further analyses (Figure 2-2).

Twenty-eight species found in the study area did not occur on the working list of Washington mosses, and 17 did not occur on the ICBEMP list (Table 2-1). Thirty-one of the species in the present study occurred as rare on the ICBEMP list and 9 occurred as rare on the WNHP list.

Seventeen of the species not found on the Washington list occurred in the rare frequency group, ten occurred on the frequent list and the remaining one occurred in the common group (Table 2-1). Eight of the species not found on the ICBEMP list occurred in the rare frequency group and nine occurred in the frequent group. Twenty-three of the rare species on the ICBEMP list occurred in the rare frequency group, 6 occurred in the frequent group and 2 in the common group.

Seven species (*Aloina rigida*, *Bryum turbinatum* and *Grimmia reflexidens* in the rare group and *Desmatodon convolutus*, *Orthotrichum pellucidum*, *Pseudoleskeella tectorum* and *Timmia megapolitana* var. *bavarica* in the frequent group) found in the study area did not occur on any of the lists compared (Table 2-1).

Fourteen species (r=12, f=1, c=1) did not occur on the Washington list, but occurred as rare on the ICBEMP list (Table 2-1). An additional seven species (r=2, f=5) did not occur on the Washington list but did occur on the ICBEMP list. Ten species (r=5, f=5) occurred on the Washington list, but did not occur on the ICBEMP list. In addition, seventeen species (r=11, f=5, c=1) occurred on the Washington list and occurred as rare on the ICBEMP list.

Four species on the WNHP rare working list occur in the rare species group (Table 2-1). These include *Bryum calobryoides*, *Meesia triquetra*, *Buxbaumia aphylla* and *Buxbaumia viridis*. Four more occur in the frequent group including *Orthotrichum hallii*, *Helodium blandowii*, *Herzogiella seligeri* and *Polytrichum strictum*. The remaining WNHP rare species, *Ptilium crista-castrensis,* occurs as a common species in the study area. Five of the nine WNHP rare species are not considered rare on the ICBEMP list.

Taxonomic and morphological patterns

Lineage analysis showed that 29.2% of all mosses occur in the Hypnales followed by the Bryales (19.1%), Dicranales (18.2%) and Pottiales (13.4%) lineages (Figure 2-3). Small percentages occurred in the Orthotrichales (6.2%), Polytrichales (6.2%), Isobryales (3.3%), Sphagnales (2.4%), Funariales (1.4%), and Andreaeales (0.5%) lineages. The Pottiales (X^2=5.664, df=2, p=0.06) and the Hypnales (X^2=4.368, df=2, p=0.11) lineages showed the greatest differences from expected frequencies according to chi-square goodness of fit tests (Figure 2-3). Patterns for other lineages could not be distinguished from random (p>0.15). Rare species showed relatively even frequency in all groups but contained slightly higher representation in the Isobryales, Polytrichales and Sphagnales lineages. Frequent mosses showed high over-represention in the Pottiales and lesser over-representation in the Andreaeales, Dicranales, and Orthotrichales lineages. Common mosses were most over-represented in the Hypnales lineage with slight over-representation in the Bryales lineage.

Sixty-six percent of all the species exhibited the acrocarpous growth form, leaving 33% as pleurocarpous. Common mosses were over represented in the pleurocarpous growth form and conversely under represented in the acrocarpous growth form (Figure 2-4). Rare and frequent mosses showed higher than expected values in the acrocarpous growth form and lower than expected values in the pleurocarpous growth form. The differences shown did not represent significant differences ($p>0.15$) according to chi-square goodness of fit tests.

Habitat availability

Rare mosses occupied 40.6%, frequent mosses occupied 34.7% and common mosses occupied 50.2% of their available landscape patches (Figure 2-5). A one-way ANOVA of lognormal percentages with Tamhane multiple comparisons revealed that common mosses had significantly higher percent occupation than frequent or rare mosses, but frequent and rare mosses did not differ significantly from one another. In contrast, the number of landscape patches available for each species did differ significantly for all three groups (Figure 2-6), with common mosses having significantly more available patches than frequent mosses and frequent mosses having significantly more available patches than rare mosses.

Microhabitat availability can influence the types of mosses that can occur in a site. In this analysis, I compared sites with rare species against sites without rare species with respect to number of microhabitats available in each site. Sites with rare species did not have more available microhabitats than sites without rare species ($t=0.844$, $df=139$, $p=0.40$).

Ecological patterns

Of the five substrate classes, rare species occurred most often on soil (including bare soil, organic and mineral, soil over rocks, but not including peat) at 38.2% (Figure 2-7). Rock substrates accounted for 30.9% of the substrate preferences, whereas peat accounted for 19.1% of the occurrences of rare species (Figure 2-7). The remaining substrate preferences included rare mosses that occurred on rock in running water (5.9%) or on wood substrates (5.9%, Figure 2-7). Peatlands occurred infrequently in the Okanogan Highlands area, yet constituted 19.1% of the substrate preference for rare mosses.

Rare mosses occurred in all mesohabitats (Figure 2-8), with 30.8% occurring in upland habitats, 26.5% in stream habitats, 22.1% in fen habitats and 16.2% in cliff habitats. Talus, spring and wetland habitats had relatively low percentages (2.9%. 5.9% and 7.4%, respectively) of rare species. Likewise, rare species occurred in all biophysical environments (Figure 2-9), but most occurred in the warm-dry biophysical environment (30.1%), followed by the cold-dry biophysical environment (22.1%). Cool-dry, cool-mesic, hot-dry and non-forest biophysical environments all contributed to more than 10% of the rare species. The remaining biophysical environments, cold-mesic, riverine and subalpine contributed the remaining 17.7% of the rare species.

The combination of mesohabitat and biophysical environment, here termed landscape patch, provided more information on how rare species were patterned on the landscape than they did individually. The rare moss rate, the number of rare moss species that occurred per site in each landscape patch, showed the relative contribution of each landscape patch to rare species occurrence (Table 2-2). Rates greater than 1.0 are in bold face to show their greater contribution to the rare moss flora.

Upland habitats contributed to 30.8% of the rare species and most of this contribution occurred in the riverine (5), warm-dry (5) and cold-dry (9) biophysical environments. Riverine and cold-dry biophysical environments had greater than 1.0 rare moss rates. The majority of the rare moss species in the stream mesohabitat came from the non-forest (4), warm-dry (8), cool-mesic (4) and cold-dry (3) biophysical environments. Only the warm-dry and cold-dry streams had high rare moss rates. The fens that occurred in the hot-dry, cool-dry, cold-mesic and cold-dry biophysical environments all contributed greatly to the rare moss flora of the study area. These six fens had some of the highest rare moss rates in the study and make up over 20% of the rare flora. Cliffs contributed a fair percentage of rare species, but most of these occurred in the warm-dry and cool-mesic biophysical environments. Both of these landscape patches had high rare moss rates at 1.2 and 2.5, respectively.

None of the landscape patches in the talus, spring or wetland mesohabitats had greater than 1.0 rare moss rates. For talus slopes, the warm-dry biophysical environment contributed the only two rare moss species. Non-forest and cool-dry springs each offered two species to the rare species flora. Six rare species occurred among the 23 wetland mesohabitats, but these were spread out among five of the seven surveyed biophysical environments so that none of the landscape patches made a significant contribution to the rare moss flora.

Geographic patterns

With regard to phytogeographic preference, the majority of species occurred in the boreal zone (52.6%) followed by the temperate zone (29.7%, Figure 2-10). Cosmopolitan (8.1%), montane (7.2%) and arctic-alpine (2.4%) made up the remaining phytogeographic categories. Chi-square goodness of fit tests showed that rare, frequent and common species occurred at rates significantly different from the expected rates in the cosmopolitan and temperate phytogeographic categories (Figure 2-10). Common species dominated the cosmopolitan category, without any representation from rare species ($X^2=19.176$, df=2, $p<0.001$). Conversely, rare species were over-represented and common species were under-represented in the temperate category ($X^2=7.194$, df=2, $p<0.05$).

The majority of species occurred in a continuous world distribution (51.7%), followed by disjunct (24.9%), North American endemic (15.3%) and cosmopolitan (8.1%) distributions (Figure 2-11). Chi-square goodness of fit tests showed that rare, frequent and common species occurred at rates significantly different from the expected rates in the cosmopolitan, disjunct and North American endemic world distribution categories (Figure 2-11). Cosmopolitan species were over represented by the common species ($X^2=19.176$, df=2, $p<0.001$). Frequent species occurred at a higher than expected rate in the disjunct category ($X^2=10.308$, df=2, $p<0.01$) and rare species occurred more than expected in the western North American endemic category ($X^2=8.310$, df=2, $p<0.025$).

Discussion

Species list comparisons

Many studies have reported the commonality of rare species (Drury 1974; Vitt 1991a; Vitt & Belland 1995, 1997). The results here match those findings, with 33% of the mosses species in the study occurring in one or two sites.

The comparison of the benchmark species list for the Okanogan Highlands with the known lists for the area emphasizes the lack of information available for bryophytes in the area. For example, a significant portion of the mosses (13.4%) had not been previously recorded in Washington. The dry, interior of Washington, including the Okanogan Highlands, have been virtually overlooked bryologically (Christy & Harpel 1995, 1997).

Seven species did not occur on either the Washington list or the ICBEMP list. *Grimmia reflexidens* was not recognized in Lawton (1971), and taxonomic difficulties in the Grimmiaceae have obscured identifications. This species, verified by Roxanne Hastings (2001), is known from mountainous regions throughout the world (Muñoz 1998b). Lawton (1971) lists the ranges for 4 of these species, *Bryum turbinatum*, *Orthotrichum pellucidum*, *Pseudoleskeela tectorum* and *Timmia megapolitana* var. *bavarica*, as based primarily in the Rocky Mountains, which would, in fact, be outside the scope of both the Washington list and the ICBEMP list. *Aloina rigida* has a scattered distribution also outside the scope of the two lists (Lawton 1971). Lawton (1971) does not mention *Desmatodon convolutus*, and Flowers (1973) limits its range to southern Utah and Arizona to Southern California and Mexico. This would again fall outside the scope of these two lists. McIntosh (1989), however, lists *Desmatodon convolutus* as common in the semiarid steppe of northwestern North America. The majority of his study area lies in British Columbia, just north of the present study area (McIntosh 1989). This species, therefore, is not unexpected in the area, but would have been outside the scope for the Washington and ICBEMP lists. If no other herbarium or literature listings exist for these seven species, then they represent extensions to the known ranges.

The Washington and ICBEMP lists represent different geographical areas, so it makes sense that not all the species will coincide between them. The majority of the species that occur on the ICBEMP list but not on the Washington list are northern boreal/peatland species (e.g. *Calliergon richardsonii*, *Meesia longiseta*, *Paludella squarrosa*, *Tomenthypnum nitens*) or have ranges that follow the Rocky Mountains and extend eastward (e.g. *Desmatodon cernuus*, *Plagiomnium cuspidatum*, *Cynodontium strumiferum*). These northern and eastern elements would likely be missed by the bryological explorations in Washington that have focused in the Cascade Mountains (Christy & Harpel 1997) or west of the Cascades where the bryoflora is rich due to high moisture levels.

The reasons for being listed on the ICBEMP list and being listed on the Washington list are not as clear. These species occur in Washington, according to Lawton (1971) and some of their ranges extend east (e.g. *Encalypta procera*, *Hygrohypnum molle*, *Tortella fragilis*). Lawton (1971) listed these as occurring in mountainous regions, which may be why they were excluded from the intermountain, ICBEMP area. The mountains of the Okanogan Highlands seem to provide habitat for these mosses that were thought to only occur in the Cascade and Rocky Mountain ranges.

Of the thirty-one species listed as rare by the ICBEMP, 23 of these occurred in the rare frequency group, 6 in the frequent group and 2 in the common group in this study. Christy and Harpel (1997) stated that the bryoflora of the intermountain region lacked basic ecological and distributional information and hypothesized that many of the "rare" taxa would prove to be more common with further exploration of the area. The findings of the present study confirm this hypothesis, and support the removal of some of the more frequent species (five of the species occur in more than five sites) from the "rare" category on the ICBEMP list.

This finding would also hold true for the rare species listed on the WNHP list. Eight of the nine listed species that occurred in the study area were not known to occur in Okanogan County (Washington Natural Heritage Program 1997). I found 19 populations of *Ptilium crista-castrensis* and five populations of *Orthotrichum hallii* and *Helodium blandowii*. Perhaps these more common elements could be removed from the list, and species not previously known to occur in Washington could be added.

Taxonomic and morphological patterns

Vitt and Belland (1997) concluded that taxonomic and morphological properties of moss species influenced their abundance. They found that rare mosses were over-represented by the Funariales, Bryales and Dicranales lineages and under-represented in the Sphagnales, Orthotrichales and Hypnales lineages (Vitt & Belland 1997). The data corroborate general over-representation of non-rare species in the Hypnales. Rare species show near to expected rates for all lineage classes. Mosses in the Sphagnales show an opposite trend to Alberta, with no representation by common species in the group in the Okanogan Highlands. Mosses in the Funariales and Bryales show strong rare representation in Alberta (Vitt & Belland 1997), but show no trend in my study. On the other hand, the Pottiales shows high representation by frequent species, but shows no trend in Alberta (Vitt & Belland 1997). These differences are likely due to the relative importance of these groups on the landscape. For example, species of Sphagnales play a dominant role in Alberta, but occur very infrequently in the Okanogan Highlands.

Vitt and Belland (1997) also found that common species over-represented the pleurocarpous mosses. The results here show some agreement, but the difference is not significant (p=0.15). The findings here provide some evidence for taxonomic and morphological properties affecting moss abundance. The differences may be obscured by the use of three frequency groups compared with the two of Vitt and Belland (1997).

Habitat availability

The estimate of habitat availability reveals that common mosses inhabit a larger variety of patches as well as a larger proportion of the available patches than frequent or rare mosses. Rare mosses occur at a higher rate on their available patches than do frequent mosses, yet they inhabit significantly fewer patches than frequent mosses. This supports the theory that rare mosses are rare because their habitats are rare (Slack 1992; Vitt 1991a).

Vitt and Belland (1997) state that the quantity and quality of microhabitats can help pattern the rare species on the landscape. This analysis, however, shows that the number of microhabitats does not affect the presence of rare species. Perhaps the more important attribute for rare species is the quality or uniqueness of the microhabitat, which was not analyzed here.

Ecological patterns

The substrate preferences seen here for rare species reflect the same differences as Alberta rare mosses in Vitt and Belland (1997). I separated out peat as a substrate because of its unique occurrence in the Okanogan Highlands, but this added with the soil category would nearly equal the soil category of Vitt and Belland (1997), as does the rock substrate category. These substrate types are important for the presence of rare species. Peat, only occurring in peatland mesohabitats (N=7) in this study, accounts for 19.1% of the substrate preference. This relatively high contribution to the rare moss flora should indicate high conservation value for any peat substrates in the Okanogan Highlands area. The contributions of soil and rock do not help in defining rare moss occurrence because these substrates occur in most of the sites in the study area.

Vitt and Belland (1997) found that restricted mesohabitats, namely cliff, alpine, aquatic and peatland habitats, contained more rare moss species (74%) than the unrestricted mesohabitats (26%), such as forests and grasslands. The unrestricted mesohabitats (uplands), in this analysis, account for 30.8% of the rare species. The restricted mesohabitats, streams, fens cliffs, talus slopes, springs and welands, provide for the remaining 69.2% of the rare species in the area. Thus, the restricted mesohabitats are important landscape components for rare species occurrence in support of Vitt and Belland's (1997) conclusions.

Upland mesohabitats remain a relatively important component for rare species, offering habitat for nearly one-third of the rare species. The analysis of landscape patches shows that the most important upland types occur in the riverine and cold-dry biophysical environments. These landscape patches show limited distribution and represent some of the most unique upland types within the study area. The upland importance for rare species must also be considered in light of sampling intensity. Uplands make up the large extent of the study area, where 55 sites were sampled. The rare species that occur in these upland mesohabitats will likely occur in other unsampled areas. This likelihood decreases in the other mesohabitats where I sampled a larger proportion of the available patches.

The landscape patches that show high rare moss rates provide environments needed by a higher percentage of rare mosses. Several of the sites (e.g. fens, a waterfall, a high elevation stream) represent unique habitats on the landscape. These patches, with high rare moss rates, should therefore hold higher conservation value than those that have low rare moss rates.

Geographic patterns

The study area occurs in the transition zone between the boreal and temperate phytogeographic zones, however, over half of the species in the study show boreal affinity. Vitt and Belland (1997) found that rare mosses did not outnumber the common ones within the boreal category. Rare mosses did, however, outnumber the common ones in the temperate category (Vitt & Belland 1997). The findings here show similar results with rare species occurring at similar rates to frequent and common mosses within the boreal category, but at significantly higher rates within the temperate category.

In world distribution patterns, rare moss species are over-represented in the endemic distribution, while frequent moss species are over-represented in the disjunct distribution and common species in the cosmopolitan distribution. This difference shows that when species are limited in distribution on a world scale (endemic) then they are also limited in distribution at the local scale (rare). On the other hand, cosmopolitan species, which grow in many phytogeographic zones and occur on all continents, occur commonly at a local scale. Disjunct species, which occur discontinuously on a world scale, occur at intermediate rates at the local scale.

One of the main theories for bryophyte species distributions states that species are dispersal limited (van Zanten and Pócs 1981). While the results of the world distribution analysis could show support for this theory, another possibility exists. The habitat availability analysis shows that rare species were limited because of fewer available landscape patches, not because they occupied a lower percentage of available patches. Söderström (1990) has discussed the dynamics of distributions with respect to temporary, patchy substrates. As distance between patches increases, the probability of a propagule reaching a suitable environment decreases. It could be that rare species are more often endemic species because of a lack of suitable habitats that are widely spaced, not because the species disperse poorly. Further investigation on the habitat availability theory is needed.

Conclusions

The present study underscores the need for increased inventory and basic distributional and ecological studies in the understudied dry, interior regions of Washington. Without a published checklist of Washington mosses, it is difficult to report new species to the area as well as assess which species may be considered rare at the state level. Slack (1992) and Söderström et al. (1992) affirm that the lack of occurrence and distribution data inhibit well defined conservation strategies.

The present study has revealed several patterns associated with rare moss species in the Okanogan Highlands. Taxonomic and morphological characteristics show slight differences with respect to evaluating patterns of rarity, however these patterns differ between geographic areas. Microhabitat quantity does not determine rare species occurrence, however, the quality or uniqueness of the microhabitats may be of importance. Restricted mesohabitats are important landscape components associated with high rare moss species occurrence. Further, unique sites at any scale (i.e. microhabitat, mesohabitat, landscape patch) offer habitat for rare species. Moss species with temperate affinities and North American endemic distributions show higher rates of rare occurrence.

This study also provides evidence that dispersal habitat availability may dictate species distributions, but further investigation is needed.

Management recommendations

I recommend further bryological exploration in the Okanogan Highlands as well as other understudied areas of Washington State. I recommend for the production of a checklist for the mosses of Washington, as well as further iterations of the "rare" moss lists produced by the Washington Natural Heritage Program and the ICBEMP project based on updated information. Land managers in the state work to incorporate these "rare" species into their management strategies. This effort, when based on dated and/or rudimentary information, can lead to time, energy and money spent on species that may not need conservation and miss species that truly are rare but remain undiscovered.

The rarity considered in this analysis refers to local rarity, or those species that occurred at only one or two sites in the study area. These species may not be threatened or endangered at a larger scale, yet without further information, selective conservation strategies are misguided (Söderström et al. 1992). If we conserve rare species at the local scale, then we ensure conservation at regional and global scales as well.

When considering rare moss conservation at the landscape level, a coarse filter approach emerges. Haufler et al. (1996) state that a coarse filter partitions the landscape based on ecological, biological, or operational similarities. This study shows that restricted mesohabitats contain more rare species than unrestricted mesohabitats. More specifically, peatlands are the most important restricted mesohabitat, followed by streams and cliffs. Conservation efforts for these habitats should take precedence. Talus slopes, springs and wetlands are, however, relatively unimportant for rare species and should receive a lower priority for conservation efforts. These mesohabitats can therefore offer land managers a coarse filter for their management efforts.

This coarse filter approach does not preclude the need for more detailed studies on rare mosses in the area. In their coarse filter approach, Haufler et al. (1996) recognized the need for species assessments to ensure that the coarse filter provided for the needs of all species. Coarse filter requires a monitoring feedback loop. Further, this studies shows that unique sites, at any scale, should be considered as potential habitat for rare moss species and should be surveyed prior to disturbance. The coarse filter approach does, however, provide a framework for land managers to prioritize their conservation efforts for rare mosses.

Table 2-1. Moss species compared to existing and rare species lists in the study area. Moss species are grouped by frequency category (rare, frequent and common). The Washington list is a working list compiled for the state of Washington (n=not on list, y=on list). The ICBEMP list is a combination of a database of mosses for the ICBEMP project compiled by Christy and Harpel (2002) and a published list (Christy and Harpel 1997) of rare mosses for the ICBEMP project (n=not on list, y=on list, r=listed as rare in ICBEMP area). The WNHP list is a working listed of rare moss species produced by the Washington Natural Heritage Program (1997), (r=on rare species list). Species nomenclature follows Anderson et al. (1990) except for those indicated by footnotes.

Species name	Washington list	ICBEMP list	WNHP list
Rare frequency group			
Aloina rigida	n	n	
Bryum turbinatum	n	n	
Grimmia reflexidens[1]	n	n	
Brachythecium bolanderi	n	r	
Bryum calobryoides	n	r	r
Calliergon richardsonii	n	r	
Desmatodon cernuus	n	r	
Dicranum elongatum	n	r	
Drepanocladus sendtneri	n	r	
Limprichtia revolvens	n	r	
Meesia longiseta	n	r	
Meesia triquetra	n	r	r
Paludella squarrosa	n	r	
Physcomitrium washingtoniense	n	r	
Plagiomnium cuspidatum	n	r	
Cynodontium strumiferum	n	y	
Sphagnum teres	n	y	
Bryum subapiculatum	y	n	
Fontinalis hypnoides	y	n	
Polytrichum longisetum	y	n	
Schistidium flaccidum[2]	y	n	
Tortella fragilis	y	n	
Brachythecium holzingeri	y	r	
Buxbaumia aphylla	y	r	r
Dicranella palustris	y	r	
Dicranum montanum	y	r	
Hamatocaulis vernicosus	y	r	
Orthotrichum holzingeri	y	r	
Orthotrichum pumilum	y	r	
Racomitrium brevipes	y	r	
Racomitrium fasciculare	y	r	

Table 2-1 (continued)

Species name	Washington list	ICBEMP list	WNHP list
Timmiella crassinervis	y	r	
Tortula latifolia	y	r	
Amphidium lapponicum	y	y	
Anacolia menziesii	y	y	
Bryum gemmiparum	y	y	
Bryum miniatum	y	y	
Bryum pallescens	y	y	
Buxbaumia piperi	y	y	
Buxbaumia viridis	y	y	r
Calliergon giganteum	y	y	
Claopodium bolanderi	y	y	
Dichelyma uncinatum	y	y	
Ditrichum flexicaule	y	y	
Fontinalis antipyretica	y	y	
Grimmia pulvinata	y	y	
Gymnostomum aeruginosum	y	y	
Hygroamblystegium tenax	y	y	
Hypnum circinale	y	y	
Hypnum lindbergii	y	y	
Lescuraea incurvata[3]	y	y	
Lescuraea patens[3]	y	y	
Lescuraea stenophylla[3]	y	y	
Neckera douglasii	y	y	
Orthotrichum anomalum	y	y	
Phascum cuspidatum	y	y	
Plagiomnium venustrum	y	y	
Pogonatum urnigerum	y	y	
Pohlia annotina	y	y	
Pohlia drummondii	y	y	
Racomitrium canescens	y	y	
Racomitrium sudeticum	y	y	
Sanionia symmetrica[4]	y	y	
Scleropodium obtusifolium	y	y	
Scouleria aquatica	y	y	
Sphagnum fuscum	y	y	
Sphagnum squarrosum	y	y	
Tortula brevipes	y	y	
Frequent frequency group			
Desmatodon convolutus	n	n	
Orthotrichum pellucidum	n	n	

Table 2-1 (continued)

Species name	Washington list	ICBEMP list	WNHP list
Pseudoleskeella tectorum	n	n	
Timmia megapolitana	n	n	
Hypnum pratense	n	r	
Campylium polygamum	n	y	
Pseudocrossidium revolutum	n	y	
Sphagnum russowii	n	y	
Sphagnum warnstorfii	n	y	
Tomenthypnum nitens	n	y	
Encalypta procera	y	n	
Hygrohypnum molle	y	n	
Rhizomnium pseudopunctatum	y	n	
Schistidium atrichum[5]	y	n	
Trichodon cylindricus	y	n	
Dicranella schreberiana var. *robusta*	y	r	
Didymodon rigidulus	y	r	
Didymodon tophaceus	y	r	
Orthotrichum hallii	y	r	r
Thuidium recognitum	y	r	
Aloina bifrons	y	y	
Andreaea rupestris	y	y	
Bartramia ithyphylla	y	y	
Brachythecium nelsonii	y	y	
Bryoerythrophyllum recurvirostre	y	y	
Bryum lisae var. *cuspidatum*	y	y	
Bryum muehlenbeckii	y	y	
Bryum weigelii	y	y	
Calliergon stramineum	y	y	
Desmatadon heimii	y	y	
Desmatadon latifolius	y	y	
Dichodontium pellucidum	y	y	
Dicranella crispa	y	y	
Dicranum polysetum	y	y	
Didymodon brachyphyllus[6]	y	y	
Distichium capillaceum	y	y	
Drepanocladus capillifolius	y	y	
Dryptodon patens	y	y	
Encalypta ciliata	y	y	
Encalypta vulgaris	y	y	
Fissidens bryoides	y	y	
Grimmia anodon	y	y	

Table 2-1 (continued)

Species name	Washington list	ICBEMP list	WNHP list
Grimmia laevigata	y	y	
Grimmia longirostris[7]	y	y	
Grimmia torquata	y	y	
Helodium blandowii	y	y	r
Herzogiella seligeri	y	y	r
Hygrohypnum bestii	y	y	
Hygrohypnum luridum	y	y	
Hygrohypnum ochraceum	y	y	
Hylocomium splendens	y	y	
Isopterygiopsis pulchella	y	y	
Metaneckera menziesii	y	y	
Mnium ambiguum	y	y	
Orthotrichum alpestre	y	y	
Orthotrichum cupulatum	y	y	
Orthotrichum obtusifolium	y	y	
Orthotrichum speciosum	y	y	
Physcomitrium sp.	y	y	
Pohlia proligera	y	y	
Polytrichastrum alpinum	y	y	
Polytrichum commune	y	y	
Polytrichum lyallii	y	y	
Polytrichum strictum	y	y	r
Pterygoneurum ovatum	y	y	
Racomitrium heterostichum	y	y	
Rhizomnium magnifolium	y	y	
Schistidium strictum	y	y	
Tortula mucronifolia	y	y	
Tortula princeps	y	y	
Warnstorfia exannulata	y	y	
Common frequency group			
Brachythecium oxycladon	n	r	
Tortula bartramii	y	r	
Amblystegium serpens	y	y	
Atrichum selwynii	y	y	
Aulacomnium androgynum	y	y	
Aulacomnium palustre	y	y	
Barbula convoluta[8]	y	y	
Brachythecium albicans	y	y	
Brachythecium collinum	y	y	
Brachythecium erythrorrhizon	y	y	

Table 2-1 (continued)

Species name	Washington list	ICBEMP list	WNHP list
Brachythecium frigidum	y	y	
Brachythecium hylotapetum	y	y	
Brachythecium leibergii	y	y	
Brachythecium oedipodium	y	y	
Brachythecium rivulare	y	y	
Brachythecium salebrosum	y	y	
Brachythecium velutinum	y	y	
Bryum argenteum	y	y	
Bryum caespiticium	y	y	
Bryum capillare	y	y	
Bryum pseudotriquetrum	y	y	
Ceratodon purpureus	y	y	
Conardia compacta	y	y	
Coscinodon calyptratus	y	y	
Cratoneuron filicinum	y	y	
Dicranoweisia crispula	y	y	
Dicranum fuscescens	y	y	
Dicranum scoparium	y	y	
Dicranum tauricum	y	y	
Didymodon vinealis	y	y	
Drepanocladus aduncus	y	y	
Encalypta rhaptocarpa	y	y	
Eurhynchium pulchellum	y	y	
Funaria hygrometrica	y	y	
Grimmia alpestris[1]	y	y	
Grimmia montana	y	y	
Grimmia ovalis	y	y	
Homalothecium nevadense[9]	y	y	
Hypnum revolutum	y	y	
Leptobryum pyriforme	y	y	
Leptodictyum humile	y	y	
Leptodictyum riparium	y	y	
Lescuraea radicosa[3]	y	y	
Mnium marginatum	y	y	
Mnium spinulosum	y	y	
Orthotrichum affine	y	y	
Orthotrichum laevigatum	y	y	
Orthotrichum rupestre	y	y	
Philonotis fontana	y	y	
Plagiomnium ellipticum	y	y	

Table 2-1 (continued)

Species name	Washington list	ICBEMP list	WNHP list
Plagiomnium medium	y	y	
Plagiothecium denticulatum	y	y	
Plagiothecium laetum	y	y	
Platydictya jungermannioides	y	y	
Pleurozium schreberi	y	y	
Pohlia cruda	y	y	
Pohlia nutans	y	y	
Pohlia wahlenbergii	y	y	
Polytrichum juniperinum	y	y	
Polytrichum piliferum	y	y	
Pterigynandrum filiforme	y	y	
Ptilium crista-castrensis	y	y	r
Rhytidiadelphus triquetrus	y	y	
Rhytidiopsis robusta	y	y	
Roellia roellii	y	y	
Sanionia uncinata	y	y	
Schistidium apocarpum	y	y	
Tetraphis pellucida	y	y	
Timmia austriaca	y	y	
Tortula ruralis	y	y	

[1] Muñoz 1998a
[2] Blom 1996
[3] Lawton 1971, Krieger 2002
[4] Hedenäs 2000
[5] Lawton 1971, Weber 1976
[6] Zander 1998
[7] Muñoz 1998b
[8] Includes *Barbula convoluta* var. *eustegia* (Zander 1997)
[9] Includes *Homalothecium nevadense* ssp. *nevadense* and *H. nevadense* ssp. *aeneum* (Hofmann 1998)

Table 2-2. Rare moss occurrence in different landscape patches as defined by seven mesohabitats and nine biophysical environments. Rare moss rate is the number of rare species that occur per site in each landscape patch. Bolded rare moss rates indicate a rate greater than one.

Mesohabitats Biophysical Environments	Number of sites	Number of rare species	Rare moss rate
Upland	**Total N=55**		
Riverine	N=3	5	**1.7**
Non-forest	N=7	1	0.1
Hot-dry	N=7	0	0
Warm-dry	N=10	5	0.5
Cool-dry	N=7	0	0
Cool-mesic	N=7	1	0.1
Cold-mesic	N=8	1	0.1
Cold-dry	N=5	9	**1.8**
Sub-alpine	N=1	1	1.0
Stream	**Total N=21**		
Non-forest	N=5	4	0.8
Hot-dry	N=1	0	0
Warm-dry	N=2	8	**4.0**
Cool-dry	N=2	1	0.5
Cool-mesic	N=6	4	0.7
Cold-mesic	N=4	1	0.3
Cold-dry	N=1	3	**3.0**
Fen	**Total N=7**		
Hot-dry	N=1	5	**5.0**
Cool-dry	N=2	9	**4.5**
Cool-mesic	N=1	0	0
Cold-mesic	N=1	3	**3.0**
Cold-dry	N=2	3	**1.5**
Cliff	**Total N=16**		
Non-forest	N=1	0	0
Hot-dry	N=3	2	0.7
Warm-dry	N=6	7	**1.2**
Cool-dry	N=3	0	0
Cool-mesic	N=2	5	**2.5**
Cold-mesic	N=1	0	0
Talus	**Total N=10**		
Non-forest	N=1	0	0
Hot-dry	N=2	0	0
Warm-dry	N=4	2	0.5
Cool-dry	N=1	0	0
Cool-mesic	N=1	0	0
Cold-mesic	N=1	0	0

Table 2-2 (continued)

Mesohabitats and biophysical environments	Number of sites	Number of rare species	Rare moss rate
Spring	**Total N=9**		
Non-forest	N=3	2	0.7
Warm-dry	N=2	0	0
Cool-dry	N=2	2	1.0
Cool-mesic	N=1	0	0
Cold-dry	N=1	0	0
Wetland	**Total N=23**		
Riverine	N=2	0	0
Non-forest	N=2	1	0.5
Hot-dry	N=2	1	0.5
Warm-dry	N=4	2	0.5
Cool-dry	N=3	0	0
Cool-mesic	N=5	1	0.2
Cold-mesic	N=5	1	0.2

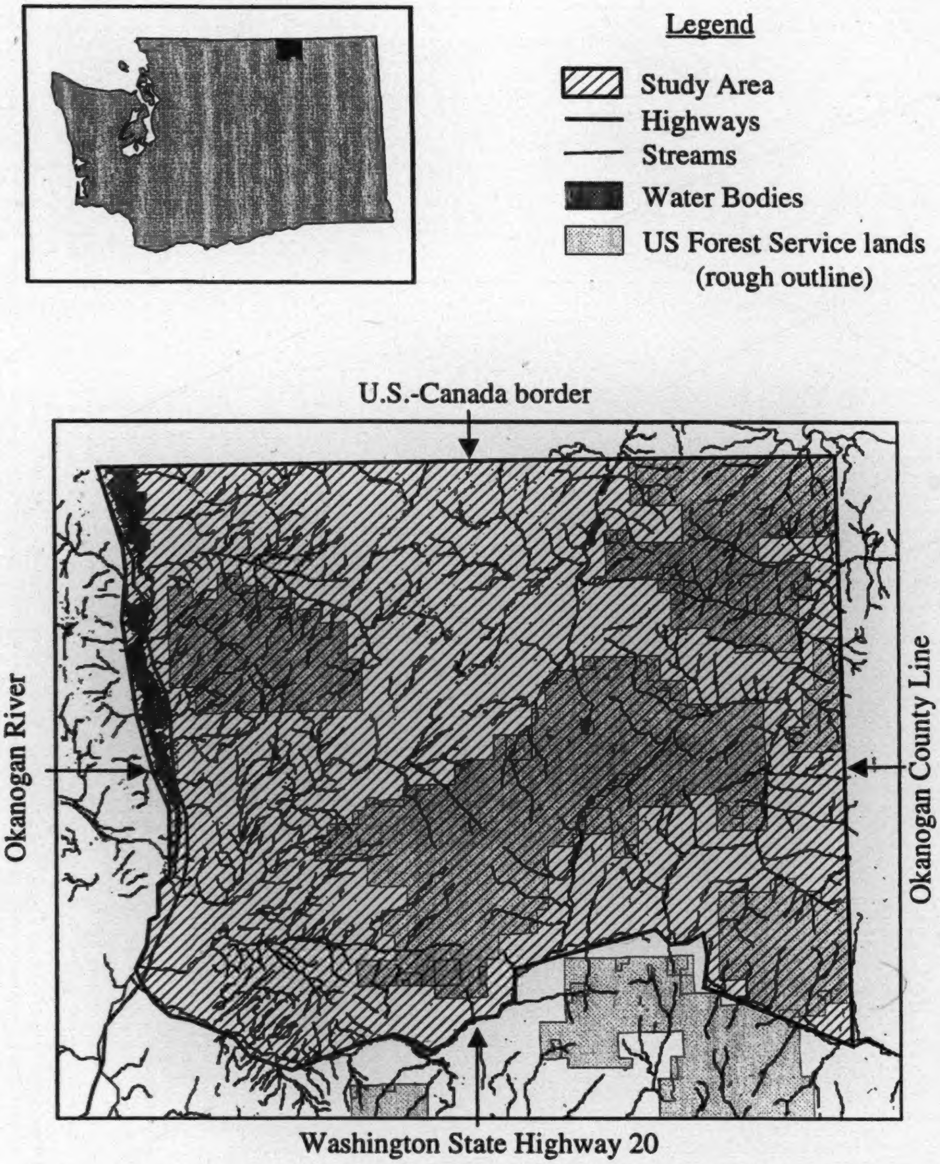
Legend
▨ Study Area
Highways
Streams
Water Bodies
US Forest Service lands (rough outline)
U.S.-Canada border
Okanogan River
Okanogan County Line
Washington State Highway 20

Figure 2-1. Map of study area located in north-central Washington State, U.S.A. The study area borders British Columbia, Canada to the north, the Okanogan County Line to the east, Washington State Highway 20 to the south and the Okanogan River to the west.

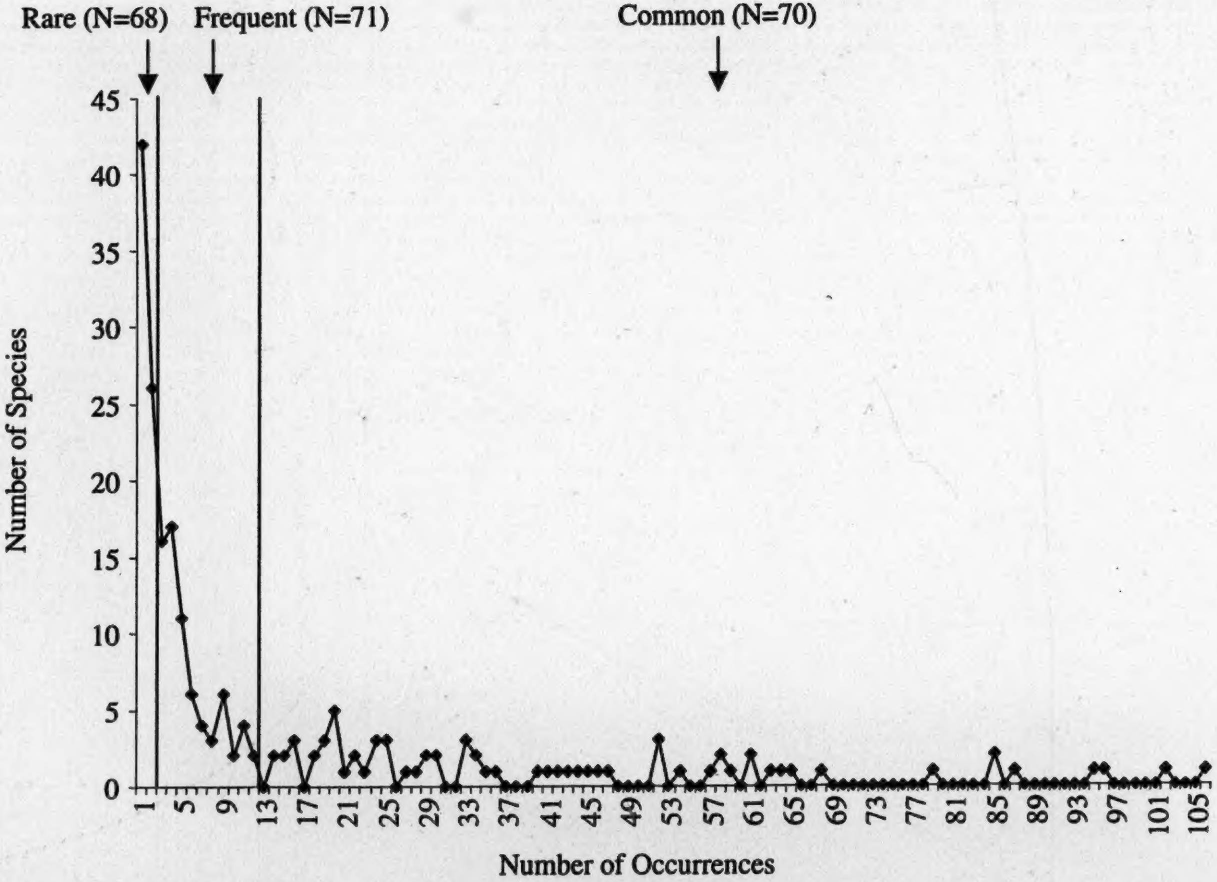

Figure 2-2. The number of occurrences for 209 moss species in the study area. The species have been divided into three near equal frequency groups (rare, frequent and common) for further analysis.

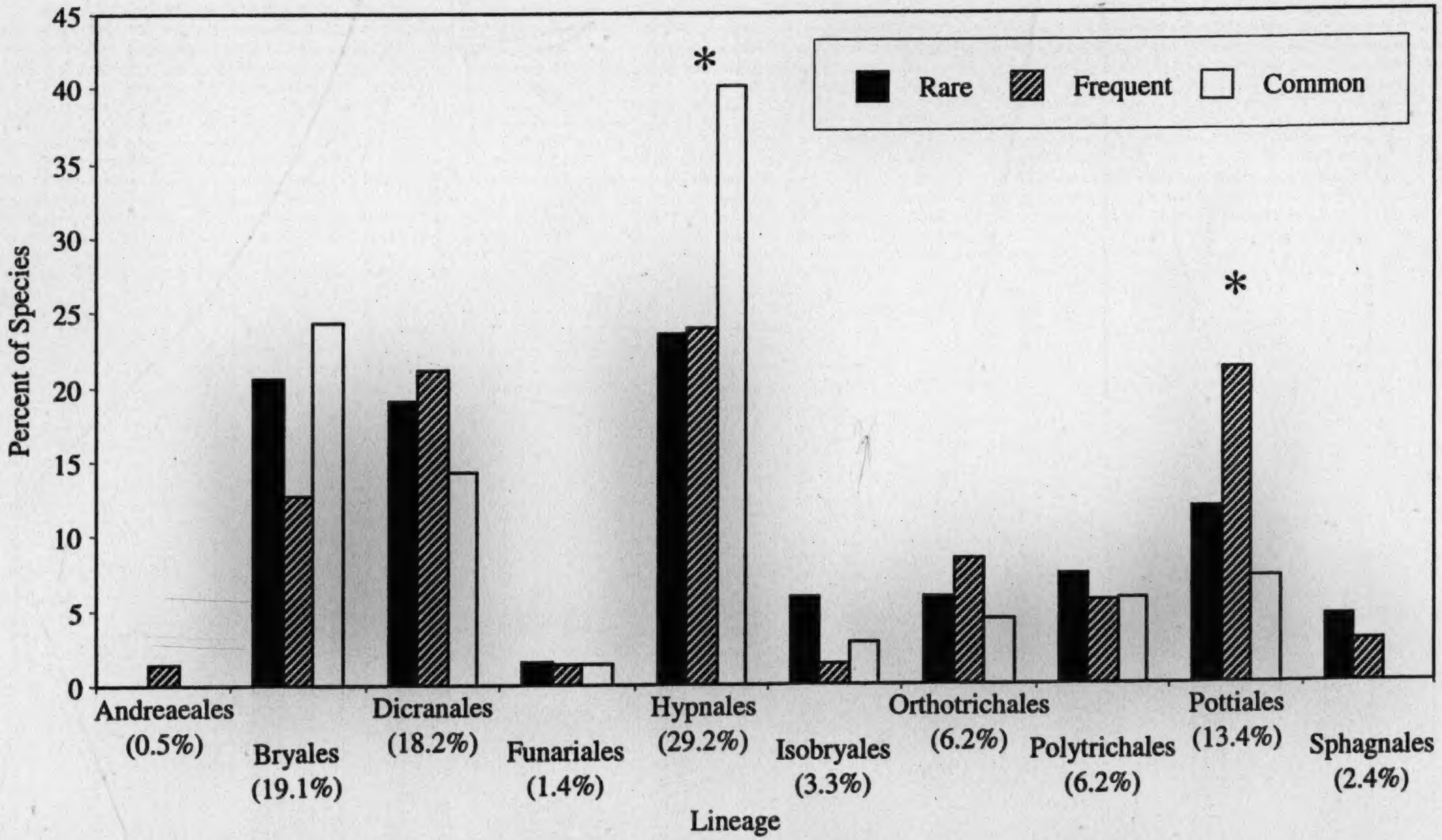

Figure 2-3. Percent of species that occur in each moss lineage. Bars on graph represent the percentage of the species in each species frequency category. Percentages under the lineage category indicate the percentage of the total species that occur in each lineage category. The asterisks indicate the groups that show a tendency toward non-random distributions within each lineage category based on chi-square goodness of fit tests. (Hypnales: X^2=4.368, df=2, p=0.11; Pottiales: X^2=5.664, df=2, p=0.06).

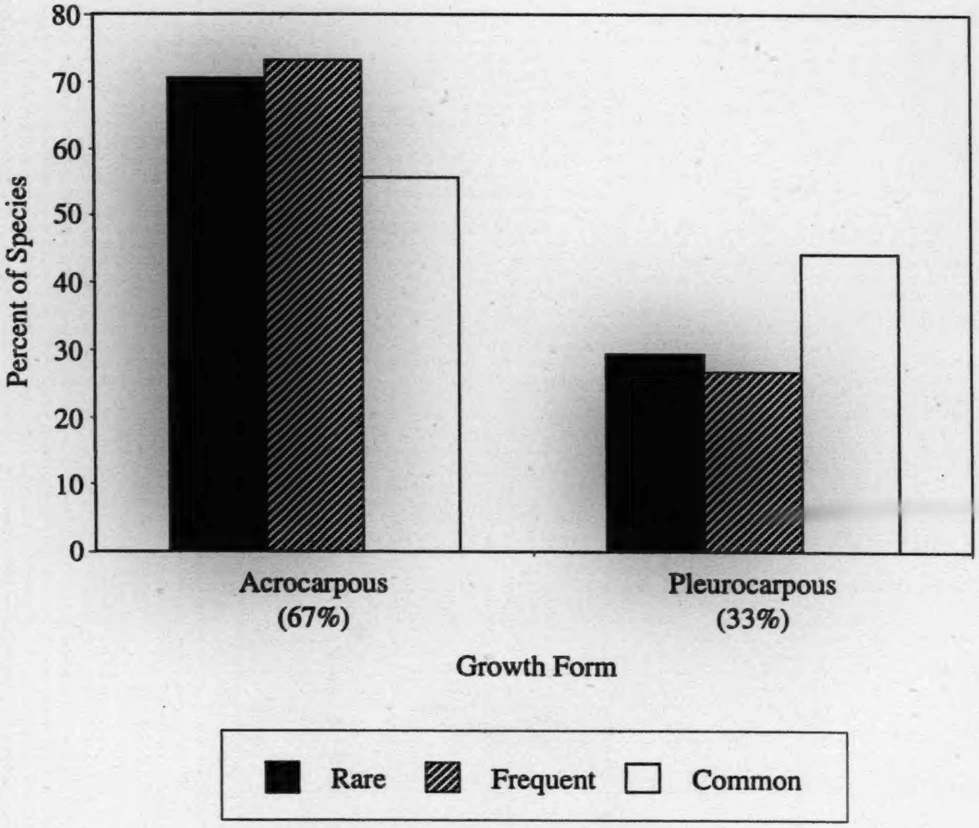

Figure 2-4. Percent of species that occur in each growth form. Bars on graph represent the percentage of the species in each species frequency category. Percentages under the growth form category indicate the percentage of the total species that occur in each growth form category.

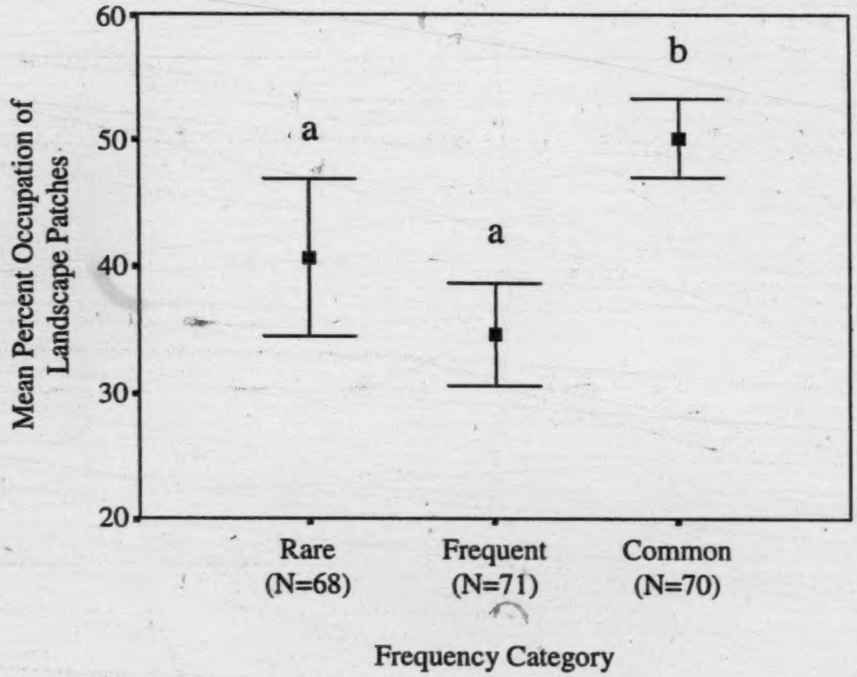

Figure 2-5. Mean percent of the landscape patches occupied by mosses in each frequency category. Error bars represent two standard errors on either side of the mean. A one-way ANOVA on the lognormal values of the percentages for each frequency category shows that the common species differ significantly from the rare and frequent species as indicated by the letters a and b.

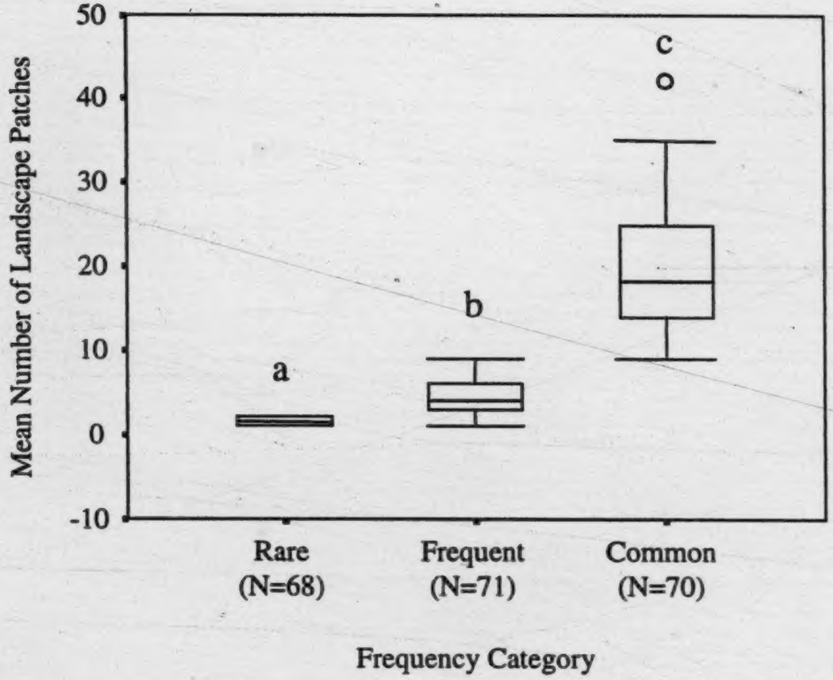

Figure 2-6. Box and whisker plot of the mean number of landscape patches in which the moss species of each frequency category occurred. A Kruskal-Wallis test with non-parametric multiple comparisons of unequal sample sizes shows that all three frequency category differ significantly from each other as indicated by the letters a, b and c.

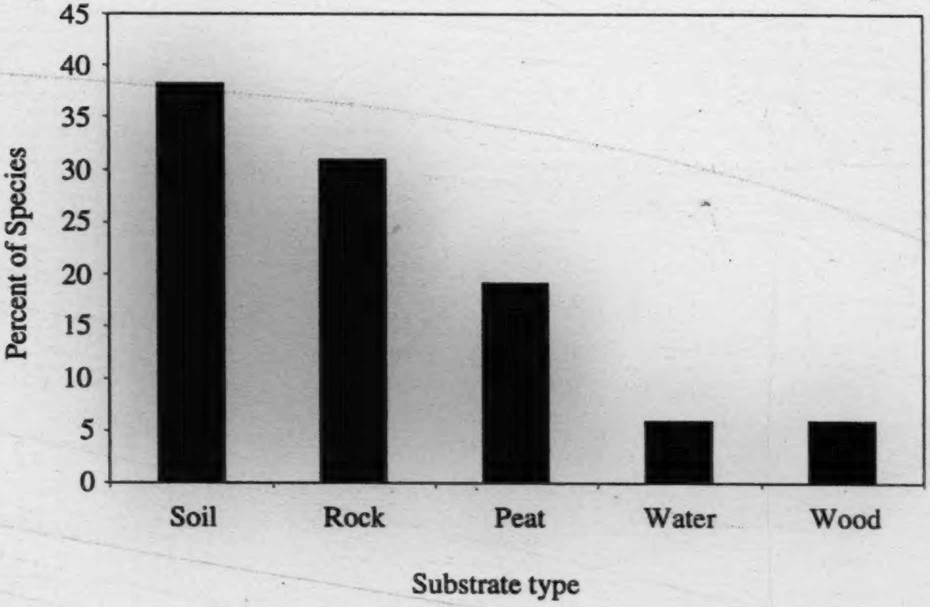

Figure 2-7. Rare species substrate preferences. Bars on graph represent the percentage of rare species in each substrate type.

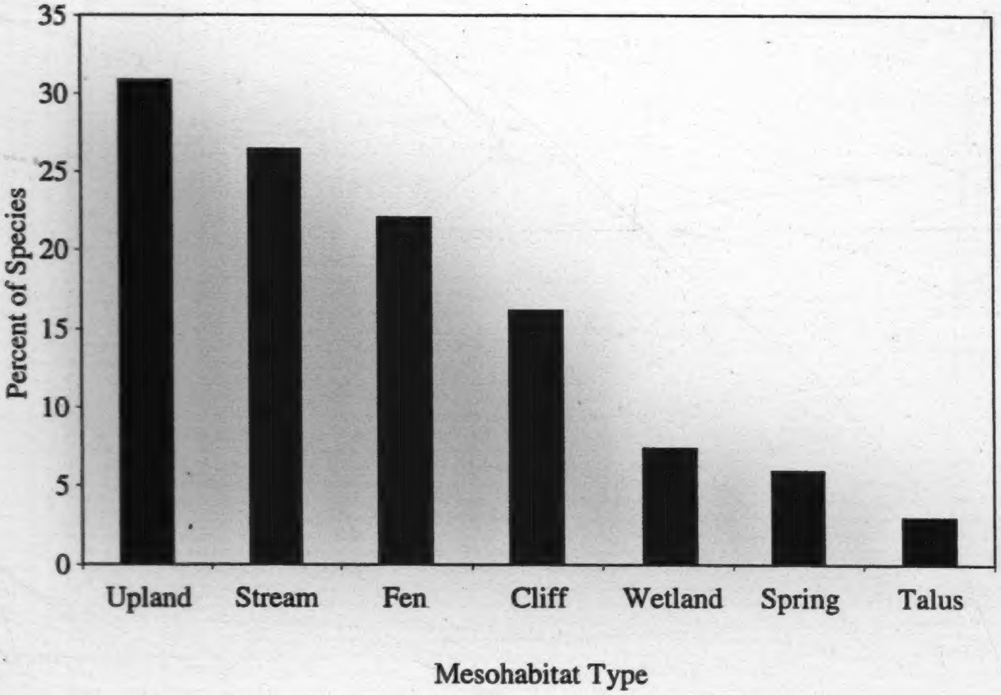

Figure 2-8. Rare species preference for mesohabitat type. Bars on graph represent the percentage of rare species in each mesohabitat type.

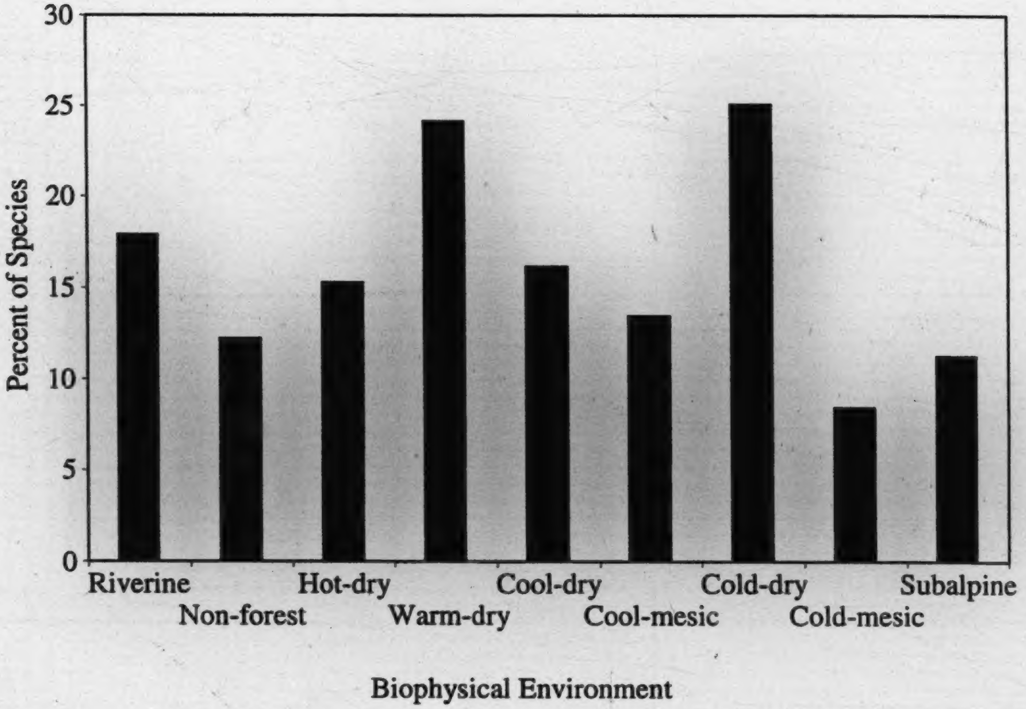

Figure 2-9. Rare species preference for each biophysical environment. Bars on graph represent the percentage of rare species in each biophysical environment.

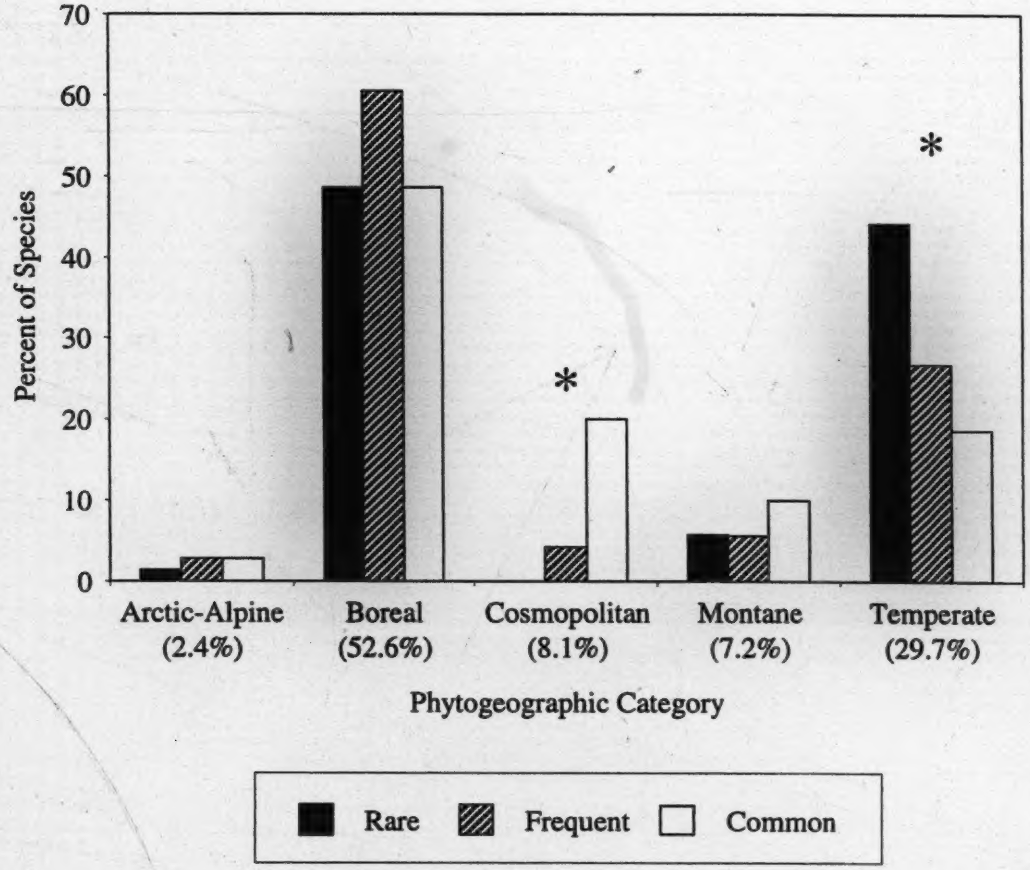

Figure 2-10. Percent of species that occur in each phytogeographic category. Bars on graph represent the percentage of the species in each species frequency category. Percentages under the phytogeographic category indicate the percentage of the total species that occur in each phytogeographic category. The asterisks indicate the groups that show non-random distributions ($p<0.05$) within each phytogeographic category based on chi-square goodness of fit tests.

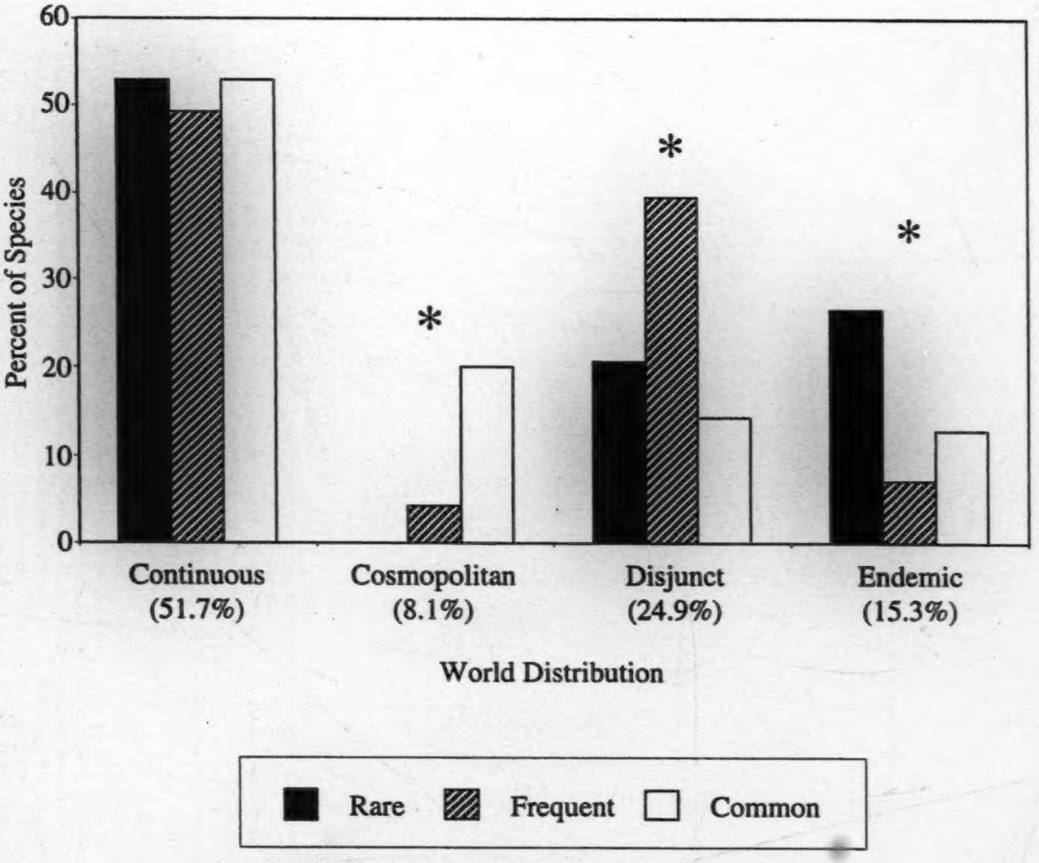

Figure 2-11. Percent of species in each world distribution category. Bars on graph represent the percentage of the species in each species frequency category. Percentages under the world distribution category indicate the percentage of the total species that occur in each world distribution category. The asterisks indicate the groups that show non-random distributions ($p<0.05$) within each world distribution category based on chi-square goodness of fit tests.

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Chapter 3.

Patterns of bryophyte richness and rarity in the Okanogan Highlands of Washington State, with guidelines for bryophyte conservation

Biodiversity has become the buzzword of recent conservation efforts. Biodiversity conveys many meanings, but in its most general sense it means variety of life forms (Burton et al. 1992). This variety of life allows ecosystems to remain productive and stable during periods of environmental stress (Burton et al. 1992). Conservation for the variety of life provides protection for organisms that could produce scientific, medical, economic or social benefits in the future (Burton et al. 1992).

Conservation efforts for biodiversity, especially protection for "rare" species, are increasing worldwide (for bryophytes, examples include Schofield 1994; Slack 1992; Söderström et al. 1992). Species rarity occurs at various scales. The majority of species in a landscape occur infrequently (Drury 1974; Newmaster 2000; Vitt 1991; Vitt & Belland 1995, 1997), thus local rarity is common. Conservation of a region's diversity relies on the protection of all species. Land managers, therefore, should be concerned with these locally rare species as well as species that may occur on endangered, threatened and sensitive species lists on a state, national or global level.

For purposes of this study, biodiversity relates to species richness. Some ecologists include the evenness, or degree of dominance, of species in their biodiversity studies (Burton et al. 1992; Whittaker 1972), however this tends to de-emphasize the importance of rare taxa (Brown & Gibson 1983), and therefore will not be considered here. The term "rare" will refer to species that occur infrequently in the study area. Conservation efforts for these locally rare species will automatically encompass rarity concerns at regional, national and global scales.

Conservation efforts for bryophytes in Washington State have just recently begun. With the adoption of the Northwest Forest Plan (United States Department of Agriculture & United States Department of the Interior 1994), land managers west of the Cascade Mountains became suddenly aware of these organisms with mandates to manage for them. Other governmental studies, such as the Interior Columbia Basin Ecosystem Management Project and the Washington Natural Heritage Program, have proposed preliminary lists of rare mosses that affect the drier eastside of Washington State (Christy & Harpel 1997; Washington Natural Heritage Program 1997). Land managers face the daunting task of managing for these small organisms.

The ability to predict areas of high bryophyte diversity or predict habitat of rare species would provide a useful tool for land managers. Multivariate ordination techniques can aid ecologists in detecting and evaluating species composition, with corresponding richness and rarity values, along environmental gradients (Doubt 2001; Heikkinen 1996; Lee & La Roi 1979; Rambo & Muir 1998).

Categorization of habitats by environmental descriptors such as landform, forest type or community type, can offer land managers a coarser-scale at which to evaluate conservation decisions. Vitt and Belland (1997), for example, related rarity of mosses in Alberta to mesohabitats, or physiognomic forms (i.e. streams, cliffs, etc.) on the landscape. Differences in richness or rarity between classes of certain environmental descriptors may provide needed direction for initial conservation efforts.

Past disturbances have likely affected the frequency and distribution of bryophyte species in the study area. Researchers have begun to study the effects of wild and prescribed fire (de las Heras-Ibáñez et al. 1991; Gorshkov & Bakkal 1996; Johnston & Elliott 1996), livestock activity (McIntosh 1986) and past logging events (Gustafsson & Hallingbäck 1988; Lesica et al. 1991; Newmaster & Bell 2002; Rambo & Muir 1998) on bryophyte communities. Evaluation of these disturbances may provide important information about their influence on patterns of bryophyte richness and rarity in the present study area.

The purpose of this study thus becomes to detect the patterns of bryophyte richness and rarity in the Okanogan Highlands of Washington State in order to propose guidelines for bryophyte conservation. More specifically, the questions of this study become:

1) Are bryophyte richness and bryophyte rarity related in the study area?

2) Which environmental characters are associated with high bryophyte richness and high numbers of rare species?

3) How do disturbance histories affect patterns of bryophyte richness and rarity?

4) Which classes of the environmental decriptors (mesohabitats, biophysical environments, bryophyte communities and spatial areas) are most important for bryophyte richness and rarity?

5) Which environmental descriptor best predicts the patterns in bryophyte richness and rarity?

Study Area

The study area encompasses a large portion (1440 km^2) of Okanogan County in the Okanogan Highlands of north central Washington State. The United States-Canadian border forms the northern boundary and Washington State Highway 20 forms the southern border. The Okanogan River flows along the western border and the study area extends east to the Okanogan county line (Figure 3-1).

For details on the physiography, geology, soils, climate, vegetation and flora, please refer to the Study Area section of Chapter 2 in this thesis.

Methods

Sampling

Some recent bryophyte diversity studies have employed a floristic habitat sampling method, as opposed to plot sampling, to ensure the capture of all species, in all habitats in the study area (e.g. Belland & Brassard 1988; Belland & Schofield 1994; Belland et al. 1992; Belland & Vitt 1995; Doubt 2001; McCune & Lesica 1992; Newmaster 2000). The floristic habitat sampling method encompasses sampling at several scales. Individual populations live in microhabitats (e.g. on logs, on rocks, on tree bases) (Vitt & Belland 1997) and the variation in microhabitats influences the local diversity (Vitt et al. 1995). Microhabitats occur in non-random patterns on the landscape based on landform and structure (Vitt & Belland 1997). These non-random mesohabitats take the form of cliffs, streams, talus slopes, etc. These restricted habitats occur within a dominant forest type, or unrestricted mesohabitat.

I sampled at the mesohabitat scale, with the sites falling into one of the following seven mesohabitat classes: upland, stream, fen, cliff, talus, spring, or wetland (see Table 3-1 for definitions of each class). Each site occurred within one of the nine biophysical environments (forest types) described in the Study Area section of Chapter 2. The BE for each site was defined by the upland (unrestricted mesohabitat) forest type. Within each site, I sampled all microhabitats present until no more species were found.

I wanted to identify all of the bryophyte species within the study area and therefore I selected sites in as many different habitats as possible. I selected sites based on my previous knowledge of the area, information from other biologists and residents in the area, as well as from studying maps and aerial photos for the area. I tried to choose unique landforms, areas of high vascular plant diversity, as well as sites typical within the landscape.

Unknown bryophyte species were collected and identified in the laboratory. For moss species, I generally followed the species concepts of Lawton (Lawton 1971), but also referenced Crum and Anderson (1981), Flowers (1973), Nyholm (1975), Spence (1988), Zander (1981, 1994, 1998), Hofmann (1998), Koponen (1974), Shaw (1982), Blom (1998) and Mishler (1994). For liverwort species, I generally followed the species concepts of Hong et al. (unpublished), but also referenced Schuster (1966-1992, 1977), Frye and Clark (1937-1947) and Paton (1999). Species nomenclature follows Anderson et al. (1990) for mosses and United States Department of Agriculture (2001) for the liverworts except for species as indicated in Appendix B. Voucher specimens are deposited at the Devonian Botanic Garden Herbarium (ALTA-DBG) and at the University of Washington Herbarium (WTU).

Environmental variables

In each site, my field assistants and I measured or estimated 24 different environmental variables (Table 3-2). We chose variables based on suspected importance to bryophyte ecology, as well as on ease of collection. We intended to capture relative differences between sites therefore we could sacrifice precise measurements for estimations of many of the environmental parameters.

In addition, we characterized each site by noting the presence of 72 predetermined microhabitats (Appendix A). We recorded whether each microhabitat occurred at the site. From this data, we determined the habitat heterogeneity of each site by summing all microhabitats present. This factor became an additional environmental variable in the CCA ordination.

Analysis

I produced bryophyte species lists for each of the 141 sites, from which I calculated the species richness at each site for all bryophyte species and for mosses and liverworts individually. I decided to designate species that occurred once or twice in the study area as locally rare, for reasons discussed in Chapter 2. The number of locally rare species that occurred in each site could then be determined for all species and for the moss and liverwort components individually.

I classified the sites according to bryophyte species composition using two-way indicator species analysis (TWINSPAN) to identify bryophyte community types (PC-ORD version 4.17 software; McCune & Mefford 1999). I reduced the number of species used in the TWINSPAN analysis by eliminating the most common species and the most rare species because these species do not help in clustering the communities. I tried two reductions (choosing species with 3 to 50 occurrences and species with 4 to 45 occurrences) and chose to reduce to species with 4 to 45 occurrences because the groups clustered more convincingly.

I used seven environmental descriptors (mesohabitats, biophysical environments, bryophyte communities, spatial areas, fire histories, livestock activities and logging histories) to detect differences in sites through different analyses (see Table 3-1 for descriptions). Each environmental descriptor contains a number of discrete groups into which sites are classified.

I used Canonical Correspondence Analysis (CCA) to ordinate the patterns in species composition to the measured environmental variables in multi-dimensional space using PC-ORD version 4.17 (McCune & Mefford 1999). The method extracts the dominant environmental relationships that relate to the species assemblages at each site (ter Braak 1994). Twenty-six environmental variables were used to constrain the CCA ordination and they were log- or arcsine- transformed, as needed, to more approximate normal distributions (Palmer 1993; Zar 1999; Økland & Eilertsen 1994).

I reduced the all bryophyte species matrix down to bryophytes with 4 to 45 occurrences as I did with the community analysis. Beals smoothing function was applied to the species matrix using PC-ORD version 4.17 software (McCune & Mefford 1999). Beals smoothing function replaces presence/absence (1/0) data with continuous probabilities (McCune 1994). McCune (1994) supports the use of this transformation for heterogeneous community data sets with large numbers of zeros. My species matrix contained 89.6% zeros, therefore, the smoothing function was deemed appropriate.

For the bryophyte CCA ordination, I calculated the bivariate means for six of the environmental descriptors (not including spatial areas). The calculated centroids for the classes with their ranges were plotted next to the ordination to ease interpretation of the classes on the ordination diagrams. I also overlaid the quantities of species richness and number of rare species for each site for all bryophytes and for the moss and liverwort components individually.

In order to assess the site conservation value, I divided the sites into three groups of richness value and three groups of rarity value. The combination (multiplication) of the richness and rarity values thus provides a site conservation value. The richness groups were based on equal occurrence values, so that Richness 1 (low) = 1-22 species, Richness 2 (moderate) = 23-44 species and Richness 3 (high) = 45-66 species. The rarity groups also divided based on nearly equal rare species occurrence values, so that Rarity 1 (low) = 0-1 rare species, Rarity 2 (moderate) = 2-3 rare species and Rarity 3 (high) = 4-7 rare species. These divisions intentionally contain fewer numbers of sites with high richness (N=14) and high rarity (N=10) values. This isolates the most important sites for richness and rarity, the combination of which provides for few sites (14, or 10% of all the sites) with the highest conservation value.

I overlaid the site conservation values on a map of sites in the study area. Conservation values are given by the product of the richness value and the rarity value and have scores of 1, 2, 3, 4, 6, or 9. Low values indicate low site conservation value and high values indicate high conservation value. I highlighted the conservation values for sites based on three environmental descriptors. One map is provided for each of the seven mesohabitats, nine biophysical environments and seven bryophyte communities.

In order to discern further the differences in species richness and number of rare species at sites, I tested them by comparison of means tests grouped by six environmental descriptors. Total species richness and moss richness followed normal distributions and I therefore ran one-way ANOVA's on them (SPSS Inc. 2001). When significant ANOVA's resulted, I performed post hoc tests (Tukey's for equal variances between classes and Tamhane's for unequal variance between classes) to detect the significant differences between the classes (SPSS Inc. 2001). Liverwort richness, total number of rare species, number of rare moss species and number of rare hepatic species did not follow normal distributions and I therefore performed Kruskal-Wallis tests on them (SPSS Inc. 2001). I performed post hoc multiple comparison tests (Zar 1999) on significant Kruskal-Wallis tests to detect differences between classes. I reduced the logging descriptor to forested sites by eliminating the non-forest biophysical environments. I reduced the livestock activity descriptor by eliminating the cliff and talus slope mesohabitats because livestock do no utilize these habitats.

I ran a linear regression of the habitat heterogeneity (number of microhabitats present in each site) against the total richness in each site (SPSS Inc. 2001). I ran a Spearman rank correlation procedure on the variables total bryophyte richness and total rare bryophyte species in each site (SPSS Inc. 2001).

I produced a sampling effort curve for all sites in the study area by using the species area curve function in PC-ORD version 4.17 (McCune & Mefford 1999). PC-ORD subsamples populations up to 500 times to obtain the average number of species for each number of samples. I produced the group gamma diversities for each class in the mesohabitat, biophysical environment, bryophyte community and spatial area environmental descriptors. These group gamma diversities represented the number of species that occurred in each of the classes based on the total sample effort in each class.

Results

Collection from 141 sites produced a total of 266 bryophyte species including 209 moss species and 57 liverwort species. The richest site contained 66 bryophyte species whereas the poorest site contained only 3 bryophyte species, with the mean richness for all sites being 28 bryophyte species. The mean moss richness per site was 24 species, with a range between 3 and 49 moss species per site. The mean liverwort richness per site was 4 species, with a range between 0 and 22 liverworts per site.

Ninety bryophyte species (68 mosses and 22 liverworts) with only one or two occurrences were determined to be locally rare. Sites contained up to 7 locally rare bryophyte species, but 82 sites contained no locally rare species. Sites contained as many as 6 rare moss species or 3 rare liverwort species.

Community analysis

TWINSPAN analysis resulted in seven bryophyte communities (Figure 3-2, Table 3-3). The first division separated communities of dry, rocky areas (indicator species identified as *Didymodon vinealis, Polytrichum piliferum, Grimmia ovalis* and *Coscinodon calyptratus*) from those of more moist and organic areas (indicator species identified as *Brachythecium erythrorrhizon*).

The dry, rocky branch of the dendrogram divided into two bryophyte communties, the *Pterigynandrum filiforme* community and the *Bryum argenteum* community. The *Bryum argenteum* community included 31 sites characterized by their occurrence on dry, low elevation slopes in sagebrush-steppe or open pine forests. This community consisted mainly of uplands (51.6%) and cliffs (19.3%) with the remaining sites occurring equally between streams, springs and talus slopes (Table 3-3). The *Pterigynandrum filiforme* community included 25 sites higher in elevation with more moisture and forest cover. This community consisted mainly of uplands (36%), cliffs (36%) and talus slopes (16%, Table 3-3). A few sites did occur in wetland and stream mesohabitats, representing sites that had rocky shorelines for these species to inhabit.

The wetter, organic branch of the dendrogram (first division) divided into two branches, the first characterized by very wet conditions (indicator species identified as *Drepanocladus aduncus* and *Plagiomnium ellipticum*) and the second characterized by moist, forested conditions (indicator species identified as *Atrichum selwynii* and *Brachythecium leibergii*). The wetter branch of the dendrogram divided further into 2 communities, the *Chiloscyphus pallescens* community and the *Leptodictyum humile* community. The *Chiloscyphus pallescens* community included 20 sites characterized by very wet, organic conditions. The community consisted of streams (50%), fens (30%), wetlands (15%) and a spring (5%, Table 3-3). The *Leptodictyum humile* community included 25 sites characterized by wet sites that occurred in lower, drier, more open areas. This community consisted mainly of wetlands (64.0%) with minor contributions by uplands, streams, a spring and a fen (Table 3-3).

The moist forest branch of the dendrogram divided into three bryophyte communities. The first division separated the drier lower elevation sites (indicator species identified as *Tritomaria exectiformis* and *Funaria hygrometrica*) from the more moist higher elevation sites (indicator species identified as *Brachythecium erythrorrhizon* and *B. oedipodium*). The former group became the *Tritomaria exectiformis* community (N=12) that mainly consisted of uplands (66.7%), but also included one wetland, one spring and two talus slopes (Table 3-3). The latter group further divided into two bryophyte communities, the *Rhytidiopsis robusta* community and the *Brachythecium erythrorrhizon* community. The *Rhytidiopsis robusta* community included 15 sites characterized by moist, forested sites with dense canopy cover. The community mainly consisted of uplands (86.7%), but also included one stream and one talus slope (Table 3-3). The remaining *Brachythecium erythrorrhizon* community contained 13 sites characterized by less canopy cover, but at least some areas of higher moisture. The community consisted of upland (38.5%), stream (23.1%), spring (23.1%), wetland (7.7%) and cliff (7.7%) mesohabitats (Table 3-3). These sites must contain some rock substrates to account for the presence of *Lescuraea radicosa* as an indicator species.

Some of the mesohabitat classes show high fidelity to specific bryophyte communities. The *Chiloscyphus pallescens* community makes up 85.7% of the fen mesohabitats and 47.6% of the stream mesohabitats. The *Leptodictyum humile* community makes up 69.5% of the wetlands. The *Pterigynandrum filiforme* community occurs in the majority of cliff sites (56.3%) and in 40% of the talus slopes. Uplands have several associated communities, especially the *Bryum argenteum* and *Rhytidiopsis robusta* communities, but also contain the majority of the *Brachythecium erythrorrhizon* and *Tritomaria exectiformis* communities. Springs are not highly associated with any bryophyte community.

Ordinations: Species, sites and environmental gradients

Canonical Correspondence Analysis (CCA) for all bryophyte species constrained by 26 environmental variables showed 42.7% of the variation in the species data explained by Axis 1 and 12.3% explained by Axis 2 (Table 3-4). The third axis explained only 3.2% of the variation and therefore is not shown on the ordination diagram (Figure 3-3A). Species-environment correlations were high (> 0.694) for the first three axes (Table 3-4) indicating that the environmental variables used were appropriate to constrain the ordination. Pearson correlations between the environmental variable and the CCA LC scores showed that 20 of the 26 variables were significant ($r > 0.164$, df = 139, $p < 0.05$) along Axis 1, 16 were significant along Axis 2, and 13 were significant along Axis 3 (Table 3-5). Because of the high number of significant variables, I chose to display only eight variables that accounted for more than 30% of the variation ($r^2 = 0.300$) on the ordination diagram (Figure 3-3A).

Axis 1 showed a decreasing moisture gradient from left to right and an increasing gradient in rock cover and slope from left to right (Figure 3-3A, Table 3-5). Axis 2 showed increasing coniferous cover (and associated increase in coniferous litter cover) and increasing elevation in the negative direction and increasing soil pH in the positive direction. The environmental variable 'elevation' acts as a surrogate for temperature in this analysis with temperature decreasing with increasing elevation.

The overlay of the mesohabitat centroids showed an association of the mesohabitats with the strong moisture gradient along Axis 1 (Figure 3-3B). The fens, wetlands and streams fell out on the left side of the ordination associated with the high moisture and high water cover environmental variables (Figures 3-3A, B). Cliffs and talus slopes fell out on the extreme right side of the ordination associated with higher rock cover and higher slopes and on the dry end of the moisture gradient. Uplands and springs, which showed higher variation in their environmental conditions, fell out between the wettest and driest mesohabitats.

The centroids of the biophysical environments primarily followed Axis 2 associated with the elevational/temperature and coniferous cover gradients, but also followed the right to left influence of increasing moisture (Figure 3-3C). The riverine sites occurred at the lowest elevation along the Okanogan River, so associated with moderate moisture, low elevation, higher temperatures, higher soil pH and low coniferous cover (Figures 3-3A, C). Non-forest, hot-dry and warm-dry sites occurred in lower elevations and on the dry end of the moisture gradient. They also correlated with higher slopes, higher rock cover and higher soil pH. The cool-dry, cool-mesic, cold-mesic and cold-dry sites cluster in the bottom left portion of the diagram associated with higher elevation, higher moisture, higher coniferous cover and lower soil pH. Within the cluster they fell out in association with the environmental gradients with cool-dry and cold-dry on the drier end and cool-mesic and cold-mesic on the wetter end, and cold-dry at higher elevations than the other three. The subalpine site fell out at the highest elevation and at the dry, rocky side of the gradient.

The bryophyte communities display as expected on the ordination diagram with respect to the environmental parameters used previously to describe them (Figure 3-3D). The *Pterigynandrum filiforme* and *Bryum argenteum* communities split initially from the other communities and these two fell out on the dry, rocky end of the gradient (Figures 3-3A, D). *Pterigynandrum filiforme* associated with lower elevations, higher temperature, higher soil pH and drier conditions. The second TWINSPAN division occurred between the wetter sites and the moist sites. The wetter communities (*Chiloscyphus pallescens* and *Leptodictyum humile*) separated well from the other three moist, forested communities. The *Chiloscyphus pallescens* community fell out at higher elevations and higher moisture conditions than the *Leptodictyum humile* community. The three remaining communities formed a cluster in the moderate moisture, higher elevation, lower temperatures, more coniferous cover and lower soil pH region of the ordination diagram. They exhibited considerable overlap in their distribution on the diagram, but the *Rhytidiopsis robusta* community associated with the higher elevations and higher coniferous cover. The *Brachythecium erythrorrhizon* community associated with slightly higher moister and lower elevations, whereas the *Tritomaria exectiformis* community associated with slightly drier conditions.

The overlay of the fire history centroids did not reveal many useful patterns (Figure 3-3E). Sites without noted fire history spread over the entire diagram as indicated by the large ranges displayed. Site with moderate fire histories occurred in slightly drier areas at higher elevations but still showed large variation (Figures 3-3A, E). Sites with high fire histories occurred at lower elevations and at the dry end of the moisture gradient.

The overlay of livestock activity centroids showed that sites without livestock activity noted had large ranges but were located in the drier, steeper locations with higher rock cover (Figures 3-3A, F). Sites at higher elevations, in moist coniferous forests had mostly light livestock activity. The moderate and heavy livestock activity occurred at lower elevations (high livestock activity at the lowest elevations) with higher soil pH in drier areas, but with considerable variation along the moisture gradient.

The overlay of the logging histories showed forested areas without logging activity noted associated with higher moisture, higher elevation and higher coniferous cover (Figures 3-3A, G). Sites with moderate to high logging histories fell out in the middle of the diagram with moderate moisture (high logging drier) at moderate elevations with lower conifer cover.

Patterns of richness and rarity on ordination diagrams

Figures 3-3H-J show the relative richness in each of the 141 sites shown. The size of the circle corresponds to the relative site richness (between 3 and 66 species per site) with larger circles representing sites of higher richness and smaller circles representing sites of lower richness. Figures 3-3K-M show the relative rarity in each of the 141 sites shown. The size of the circle again corresponds to the to the relative number of rare species (between 0 and 7 rare species per site) in each site. Large circles represent sites with many rare species and small circles represent sites with few rare species.

Total bryophyte richness tended to increase with increasing moisture (Figures 3-3A, H) with more of species rich sites occurring on the left side of the ordination diagram. In addition, more sites of moderate richness occurred in the lower, left portion of the diagram indicating increased richness with increasing elevation, decreasing temperature and coniferous cover. The moss component showed a less apparent trend in richness, although fewer low rich sites occurred on the wetter end of the gradient (Figures 3-3A, I). The richness of the liverwort component, however, was strongly correlated with moisture (Figures 3-3A, J).

Bryophyte rarity showed fewer trends with environmental gradients. Sites without rare bryophytes (smallest circles) occurred in all regions of the ordination diagrams (Figures 3-3K, L, M). Sites with more rare mosses did not necessarily contain more rare liverworts (Figures 3-3L, M). Rare mosses occurred more frequently in the upper portion of the diagram associated with lower elevation (Figures 3-3A, L) whereas the rare liverworts occurred more frequently in the lower portion of the diagram associated with higher elevation (Figures 3-3A, M). These differences resulted in an even spread of sites with rare bryophytes on the ordination diagram (Figure 3-3K).

Comparison between the richness and rarity overlays shows that many sites contain many bryophyte species (many big circles) whereas few sites contain many rare species (Figure 3-3H, K). Close comparison also reveals that the sites that contain many rare species do not necessarily occur in the richest sites.

Conservation value analysis

Analysis of the site conservation value shows that only one site shares the highest richness value and the highest rarity value (Table 3-6). The majority of sites with high rarity value (80%) occur with moderate richness value. One site has low richness, but high rarity. The majority of the sites with high richness (57.1%) occur with low rarity value, but five sites (35.7%) of the high richness have moderate rarity. Fourteen sites (10% of all sites) have high conservation value (9 = Richness 3 x Rarity 3, 6 = Richness 3 x Rarity 2, 6 = Richness 2 x Rarity 3), which are bolded in Table 3-6.

The results of the conservation value analysis are overlaid by seven mesohabitats (Figure 3-4B-H), nine biophysical environments (Figure 3-4I-Q) and seven bryophyte communities (Figure 3-4R-X). The fourteen sites with the highest conservation values have scores of 6 or 9 on the maps. The frequency of the fourteen sites with the highest conservation value are given for three environmental descriptors in Table 3-7.

The fourteen sites mainly represent stream (35.7%), fen (28.6%) and upland (21.4%) mesohabitats (Table 3-7), which can be seen on the Figures 3-4B, D, F. Wetlands have one site of high conservation value (Table 3-7, Figure 3-4C) but otherwise have sites of lower conservation value like springs and talus slopes (Figures 3-4E, H). Cliffs have one site of high conservation value, but also have several sites of moderate conservation value (Figure 3-4G). The fourteen sites spread evenly over the biophysical environments (Table 3-7, Figures 3-4I-Q). Half of the sites with high conservation value represent the *Chiloscyphus pallescens* community group (Table 3-7, Figure 3-4R). The *Pterigynandrum filiforme* community has three sites (21.4%) and the *Leptodictyum humile* community has two sites (14.3%) with high conservation value (Table 3-7, Figures 3-4W, S). The *Brachythecium erythrorrhizon* and *Rhytidiopsis robusta* communities each have one high conservation site (Table 3-7, Figures 3-4 T, U). The *Tritomaria exectiformis* and *Bryum argenteum* communities have sites with generally low conservation value (Figures 3-4 V, X). The fourteen sites of high conservation value are segregated spatially with nine of the sites (64.3%) occurring in the Bonaparte block and the other five sites (35.7%) occurring on non-Forest Service lands (Table 3-7, Figure 3-4A).

Multiple comparison analysis

Comparison of total bryophyte richness between mesohabitat classes revealed that fens and streams had significantly more species than uplands, cliffs and talus slopes (F=6.295, df=6, p<0.001, Figure 3-5A). The moss component showed significantly more moss species in streams than in uplands or talus slopes (F=4.329, df=6, p=0.001, Figure 3-5B). The liverwort species component showed significantly more liverwort species in fens and streams than in uplands and cliffs (X^2=25.479, df=6, p<0.001, Figure 3-5C).

Comparison of total bryophyte richness between biophysical environments revealed that cool-mesic and cold-mesic biophysical environments had significantly more species than the riverine, non-forest and hot-dry biophysical environments (F=8.723, df=7, p<0.001, Figure 3-6A). The moss component showed the same pattern as all bryophyte species (F=6.158, df=7, p<0.001, Figure 3-6B). The liverwort component showed significantly more liverwort species in the cool-mesic and cold-mesic biophysical environments than in the riverine, non-forest, hot-dry and warm-dry biophysical environments (X^2=64.534, df=7, p<0.001, Figure 3-6C).

Comparison of total bryophyte richness between bryophyte communities revealed that the *Chiloscyphus pallescens* community had significantly more species than the other communities whereas the *Bryum argenteum* community had significantly fewer species than the other communities (F=25.863, df=6, p<0.001, Figure 3-7A). The moss component showed significantly more species in the *Chiloscyphus pallescens*, *Brachthecium erythrorrhizon* and *Tritomaria exectiformis* communities than in the *Bryum argenteum* community (F=14.372, df=6, p=0.001, Figure 3-7B). The liverwort component showed significantly more species in the *Chiloscyphus pallescens*, *Brachythecium erythrorrhizon*, *Rhytidiopsis robusta* and *Tritomaria exectiformis* communities than in the *Bryum argenteum* community (X^2=72.639, df=6, p<0.001, Figure 3-7C).

Comparison of species richness of all sites between fire history classes revealed significant results, however upon reduction of the sites to the dry, low elevation areas that had been affected by fire (biophysical environments including riverine, non-forest, hot-dry, warm-dry and cool-dry), these differences could no longer be detected. Comparison of species richness between livestock activity classes revealed no differences.

Comparison of species richness between logging histories of forested sites revealed that sites with moderate logging (selective logging between 1940 and 1970) had significantly more species than sites with no logging history and sites with recent, intense logging history (All bryophytes: F=6.700, df=2, p=0.002; mosses: F=5.340, df=2, p=0.006; liverworts: (X^2=10.252, df=2, p=0.006, Figures 3-8A-C respectively). Further comparisons within mesohabitats did not reveal any patterns, however not all classes were comparable due to low sample sizes within some classes. Comparisons within biophysical environments showed significantly higher bryophyte species richness in the moderate logging history class than in the recent, intense logging history class (F=3.754, df=2, p=0.041) in the cool-dry biophysical environment. Bryophytes species in the no logging history class had significantly higher richness than in the recent, intense logging class (F=4.103, df=2, p=0.031) in the cool-mesic biophysical environment. The remaining biophysical environments did not have enough representatives from each logging history class to make comparisons.

A comparison between three pairs of adjacent sites, one without logging and one with recent intense logging, showed conflicting patterns. Two of the 3 pairs of sites showed a decrease in mean bryophyte richness from 36.5 in the unlogged sites to 25 species in the logged sites. The remaining pair of sites showed an increase from 26 bryophyte species in the unlogged site to 40 species in the logged site. This increase came with the presence of wet, seepy areas and a wet road cut bank that offered habitat not present in the unlogged site.

Comparisons of rare bryophyte species between mesohabitat classes revealed that fens had significantly more rare species than wetlands, springs, uplands and talus slopes (X^2=26.620, df=6, p<0.001, Figure 3-9A). The moss component showed significantly more rare moss species in fens than in wetlands, uplands and talus slopes (X^2=24.129, df=6, p<0.001, Figure 3-9B). The liverwort component did not show any significant differences (X^2=11.546, df=6, p=0.076).

Kruskal-Wallis tests did not detect any significant difference in rare bryophytes species or in rare moss species between biophysical environment classes. The liverwort component did differ significantly across biophysical environment classes (X^2=14.794, df=7, p=0.039), however post-hoc tests failed to detect any differences between the classes.

Comparisons of rare bryophyte species between bryophyte communities revealed a significant result (X^2=14.043, df=6, p=0.029), however post hoc tests failed to detect any differences. The moss component did not show any differences between bryophyte communities. The liverwort component, however, showed significantly more rare liverwort species in the *Chiloscyphus pallescens* community than in the *Bryum argenteum* community (X^2=14.947, df=6, p=0.021, Figure 3-10).

Kruskal-Wallis tests did not detect any significant differences in rare bryophyte species or in rare moss species between fire history classes. The liverwort component showed a significant test (X^2=6.148, df=2, p=0.046), however post-hoc tests failed to detect any differences between the classes.

Comparisons of rare bryophyte species between livestock activity classes revealed that sites with no livestock activity had significantly more bryophyte species than did sites with heavy livestock activity (X^2=11.897, df=3, p=0.008, Figure 3-11). The moss component did not show any significant differences. The liverwort component showed a significant test (X^2=9.352, df=3, p=0.025), however post-hoc tests failed to detect any differences.

No significant differences were detected in the number of rare species in any of the species groups between different logging histories.

A scatterplot of the number of rare species by the number of total species in each site shows great variability in these two variables (Figure 3-12). The Spearman rank correlation between these revealed a significant correlation (R=0.341, N=141, p<0.01), however the correlation explained only 11.6% of the variability in the data. The sites with the greatest number of rare species occur at moderate richness, however the sites of high richness are more likely to (but do not always) have some rare species (Figure 3-12).

Linear regression of bryophyte richness by habitat heterogeneity accounted for 27.6% of the variation in the data with the equation $y = 0.757x + 8.379$ (F=52.882, df=1, p <0.001).

Gamma diversity and unique species

The estimated gamma diversity curve for all sites levels off toward the right-hand side of the curve indicating adequate sampling effort in the study area (Figure 3-13). Capture of 266 species in the study area, therefore, represents a good estimate of the overall gamma diversity. With adequate landscape sampling, it is assumed that additional sites would not add additional species. Since I had achieved adequate sampling on the landscape level, I assumed adequate sampling for the classes within the environmental descriptors, whose gamma diversities are displayed in Table 3-8.

The spatial areas show a range in group gamma diversity between 131 (49.2%) and 214 (80.5%). The East Blocks region contains five unique species whereas the Bonaparte Block has 44 unique species (Table 3-8). Mesohabitat group gamma diversities range from 70 (26.3%) in talus slopes to 167 (62.8%) in the uplands. All mesohabitats contain unique species with the fewest occurring in the talus slopes (2) and the most in the uplands (25). Fens, with only seven sites, contained 23 unique species. Biophysical environment group gamma diversities range from 16 (6%) in the subalpine and 42 (15.7%) in the riverine to 155 (58.3%) in the cool-mesic. The subalpine site with only a sampling size of one may not represent full gamma diversity for that biophysical environment, however, it still contains one unique species. The highest numbers of unique species occur in the warm-dry and the cold-dry biophysical environments at 18. The warm-dry biophysical environment has a high gamma diversity at 151 or (56.8%), but the cold-dry has a relatively low gamma diversity at 99

(37.2%). Bryophyte community group gamma diversities range from 89 (33.4%) in the *Tritomaria exectiformis* community to 160 (60.2%) in the *Chiloscyphus pallescens* community. The *Chiloscyphus pallescens* community contains 32 unique species, nineteen more than the second highest in the *Pterigynandrum filiforme* community.

Discussion

Are bryophyte richness and rarity related in the study area?

Growing concern for conservation of biodiversity and protection of rare species has raised issues of how to efficiently meet both objectives. The problem would be easier to manage if the patterns of species richness and rarity behaved similarly. The analyses of this study provide mixed results with regard to this issue. The bryophyte richness and rarity overlays of the CCA ordination diagram show that sites that have higher numbers of rare species do not necessarily contain high numbers of species. The CCA ordination also shows correlation between between the main environmental gradients and richness, but not rarity. The analysis of conservation value shows that only one site shares top richness value and top rarity value. Most of the sites with highest rarity value occur at moderate richness and the majority of the richest sites have low rarity value. Fen mesohabitats contain significantly higher richness and significantly more rare species than other mesohabitats, but multiple comparison tests did not detect similar patterns for other environmental descriptors. These negative results agree with Prendergast et al. (1993) who found that liverwort richness and rarity did not correlate in Britain and with Doubt (2001) who found that "hotspots" of moss richness and rarity did not coincide in Waterton Lakes National Park in Alberta, Canada.

On the other hand, the Spearman's rank correlation test does show a significant correlation between richness and rarity in the study area, even though it only explains 11.6% of the variation. Similarly, Vitt et al. (2002) found increased number of locally rare species in areas of high richness in fens of Northern Alberta. The scatterplot of site richness and site rarity (Figure 3-12) may provide the link between these seemingly disparaging results. While the sites with the highest rarity values occur at moderate richness, the sites of high richness are more likely to have at least some rare species

(Figure 3-12). Thus conservation efforts geared toward preservation of site of high richness will likely protect some of the rare species in the area.

Which environmental characters are associated with high bryophyte richness and high numbers of rare species?

Richness overlays on the CCA ordination diagrams show a trend for increased richness with increasing moisture and increasing coniferous canopy cover and elevation. The liverwort component shows a stronger relationship than the moss component. Liverworts generally exhibit less tolerance for dessication than mosses (Andersson & Hytteborn 1991; Söderström 1988a). Moisture and elevation have been considered before in relation to richness and rarity patterns. Frisvoll and Prestø (1997) found higher richness of bryophytes in moist, humid forests than in dry forests in Norway. Gradstein et al. (1990) found similar results in lowland rainforest of the Guianas. Likewise, Söderström (1988b) found higher bryophyte richness, especially that of liverworts, on moist logs than on dry logs in Northern Sweden. Stark and Castetter (1987) found increased bryophyte richness with increasing elevation and moisture in New Mexico. Lee and LaRoi (1979) found increasing bryophyte richness with increasing elevation in Jasper National Park, Alberta, Canada. Further, Doubt (2001) found higher richness values in higher elevations of Waterton Lakes National Park, Alberta, Canada. Doubt (2001) also found that bryophyte species richness in Waterton Lakes National Park correlated with coniferous tree cover, cover of organic substrate and bryophyte cover. These findings agree with the richness patterns seen here with increasing coniferous cover along the Axis 2, increasing organic (decreasing rock) along Axis 1 and bryophyte cover, which wasn't shown on the diagram, but still has high correlation with Axis 1 (Table 3-5).

Rarity overlays on the CCA ordinations do not show any trends with respect to environmental variables. Sites without any rare species occur in all areas of the ordination diagrams, as do sites with many rare species (Figure 3-3K-M). A more detailed analysis of rare species patterns in Chapter 2 revealed that rare species occur in unique sites on the landscape. The rare species, therefore, occur in unique habitats throughout the landscape that cannot be generalized by the environmental gradients that I measured. In addition, sites that contain rare moss species do not necessarily contain rare liverwort species and vice versa. Doubt (2001) found that sites with different conservation values did not often overlap in their hotspots. Other attempts to find "surrogate" species for less well-known taxonomic groups have also found that different taxa do not overlap in their diversity hotspots (Dirkse & Martakis 1998; Pharo & Beattie 1997; Pharo et al. 1999; Prendergast et al. 1993). This makes pattern detection and prediction more difficult for rare species.

How do disturbance histories affect patterns of bryophyte richness and rarity?

Initial multiple comparison tests detected lower species richness in areas of high fire activity. The overlay of fire histories on the CCA diagram (Figure 3-3E) showed the high fire centroid on the dry end of the moisture gradient. The Barker Mountain Fire ran through a large portion the lower elevations in the southwest corner of the study area in 1985. This fire accounted for the majority of the high fire sites in the analysis. The detection of significantly lower species richness in the high fire history class thus became suspicious because of the detected trend between moisture and species richness in the area. To control for this factor, I ran a subsequent analysis limited to the lowest and driest habitats (included only riverine, non-forest, hot-dry, warm-dry and cool-dry biophysical environments). This test did not detect any differences between the fire history classes, so the differences detected earlier were due to the moisture gradient and not the fire history. Multiple comparisons did not detect any differences in bryophyte rarity between fire history classes. These inconclusive results are likely due to the high variability in the data as displayed on the CCA ordination overlays.

Bryophyte richness did not differ significantly between different livestock activities. The variability in the data likely obscures any trends that might be detected. Multiple comparison tests on rare bryophytes did show significantly fewer rare bryophytes in sites with heavy livestock activity than in sites without any livestock activity. Sites with heavy livestock activity tend to occur in the lower elevations and sites without livestock activity tend to occur in high elevation forests (Figure 3-3F). I initially thought that these differences may have caused differences in rarity, however, comparison of the overlay of the livestock activities (Figure 3-3F) with the overlay of the total number of rare bryophytes (Figure 3-3K) showed that sites with rare species occur within the range of both of these classes. Soil disturbance due to livestock trampling most likely affects the lack of rare species. McIntosh (1986) studied bryophytes of the semi-arid steppe region of British Columbia, just north of the present study area. He attributed the elimination of all but a few bryophytes on soil crusts to increased cattle trampling and found that most crust taxa occurred only in areas protected from trampling. Schofield (1994) also warned of the vulnerability of bryophytes in the semi-arid interior of British Columbia due to the reduction of habitat due to agricultural practices and creation of pastureland.

The comparison of bryophyte richness between logging histories revealed that sites with moderate logging had more species than sites without logging and sites with recent intense logging. This result agrees with the intermediate-disturbance hypothesis (Connell 1978), supported by other researches of succession (Lindholm & Vasander 1987; Schoonmaker & McKee 1988; Shafti & Yarranton 1973). Jonsson and Esseen (1990) found peak diversity of bryophytes in intermediate patch ages in a study of treefall disturbances. In the present study, the presence of disturbed areas due to logging and refuge areas in pockets of undisturbed areas likely increases the species richness at these intermediate ages. Previous researchers have found that stands of old-growth contain more species than younger stands (e.g. Lesica et al. 1991; McCune 1993; Newmaster 2000; Rambo & Muir 1998; Söderström 1988a). These studies compared sites of similar forest type and compared only between old-growth and yound stands. I suspect that the present results show a different trend because of the variety of forest types and ages compared.

Except for increase of richness at moderate logging, few other conclusive results regarding logging histories could be detected. In most cases, when trying to find differences within a particular mesohabitat or biophysical environment, sample sizes were to small to test or detect differences. Two biophysical environments, cool-dry and cool-mesic, had enough samples in each of the three logging history classes. Each gave significant differences with multiple comparison tests however the results differed between the two biophysical environments. In both cases the high logging class had significantly fewer species, but in the cool-dry biophysical environment it was lower than the moderate logging class and in the cool-mesic biophysical environment it was lower than the no logging class.

Further, with comparison of three pairs of adjacent sites (high logging versus no logging), I expected to find fewer bryophyte species in the logged sites (Andersson & Hytteborn 1991; Brumelis & Carleton 1989; Jalonen & Vanha-Majamaa 2001; Lesica et al. 1991; McCune 1993; Newmaster 2000; Newmaster & Bell 2002; Rambo & Muir 1998; Söderström 1988a). However, the results here showed one of three pairs of sites with more species in the logged site due to the presence of wet seeps and wet road banks that offered habitat for a new suite of bryophyte species not present in the unlogged sites.

The inconclusive findings of the logging history analysis show the complexity of analyzing such a question. First of all, logging practices in the study area have not remained constant through time. Early logging efforts focused on easily accessible areas and selectively removed the biggest trees. Managers in the area did not introduce clear-cutting techniques until the 1970's and 1980's, and more recent efforts have returned to more selective logging efforts and to leaving islands of undisturbed forests within cut-blocks. The variety of logging techniques through history complicates comparisons of older forests to younger forest in the area. Secondly, the presence of unique microhabitats, as seen in the comparison of adjacent sites, can affect site richness. Researchers have found that site richness increases with increasing habitat complexity (Crites & Dale 1998; Doubt 2001; Jonsson & Esseen 1990; La Roi & Stringer 1976; Lee & La Roi 1979; Newmaster 2000; Vitt et al. 1995). Regression analysis between habitat heterogeneity (a measure of the number of microhabitats in each site) and site richness in this study also showed significant results. Finally, the present study focused primarily on capturing all of the bryophyte species present in the study area and consequently did not capture enough replication in logging histories to adequately compare them.

Which classes of the environmental descriptors (mesohabitats, biophysical environments, bryophyte communities and spatial areas) are most important for bryophyte richness and rarity?

The task of managing for diversity and rarity can be a daunting one, especially for small and understudied organisms like bryophytes. Detection of patterns based on environmental descriptors can offer the framework for a coarse filter approach to conservation efforts. The analyses of this study detect patterns within the environmental descriptors that may guide land managers.

Multiple comparison tests show fen and stream mesohabitats with significantly more species and fens with significantly more rare species than other mesohabitats. The gamma diversity and unique species analyses show streams and uplands with the highest gamma diversities and fens, streams and uplands with the most unique species. Similarly, the conservation value analysis shows the stream, fen and upland mesohabitats with more sites of high conservation value. The three upland mesohabitats with high conservation value represent a small percentage (5%) of upland sites that typically show lower conservation value. Upland sites also have twice the number of sites with which to have higher gamma diversities and more unique species, so they are not as important as they may initially seem. The fen and stream mesohabitats, therefore, stand out from the others in their importance to richness and rarity patterns in the study area.

Multiple comparison tests show the cool-mesic and cold-mesic biophysical environments with significantly higher richness values than some of the lower, drier biophysical environments, but do not reveal any differences in rare species distributions. Gamma diversity and unique species analyses show the cool-mesic, cool-dry and warm-dry biophysical environments to have the highest gamma diversities, but the warm-dry and cold-dry ones to have the most unique species. The analysis of conservation values reveals an even spread of sites with high conservation value over all of the biophysical environments. These ambiguous results indicate that biophysical environments do not offer clear guidance with regard to conservation efforts for bryophyte richness and rarity.

Multiple comparison tests show that the *Chiloscyphus pallescens* community has significantly greater richness than all other communities. The *Bryum argenteum* community has significantly lower richness than all other communities. Rare liverworts occur significantly more often in the *Chiloscyphus pallescens* community than in the *Bryum argenteum* community. Gamma diversity and unique species analyses show that the *Chiloscyphus pallescens* and the *Pterigynandrum filiforme* communities have the highest gamma diversities and have the most unique species. These two communities also have more sites with high conservation value than the other communities. Thus the *Chiloscyphus pallescens* and *Pterigynandrum filiforme* communities emerge as important ones for conservation of richness and rarity.

Spatially, the Bonaparte block and the non-Forest Service lands contain the highest gamma diversities, most unique species and have all of the sites with the highest conservation value. These then become the most important geographic regions for conservation of bryophyte richness and rarity.

Which environmental descriptor best predicts the patterns in bryophyte richness and rarity?

The gamma diversity and unique species analyses show that any one class of any environmental descriptor on average contains only 45% (up to 80%) of the landscape diversity and that each class contains at least one unique species. None of the classes, therefore, should be ignored with respect to conservation efforts, however, some environmental descriptors may offer better guidance.

The discussion in the previous section provides guidance to the relative importance of the environmental descriptors for bryophyte richness and rarity. The Bonaparte Block and the Non-Forest Service lands show greater importance than the other two geographic areas. Unfortunately, conservation efforts on non-Forest Service lands take greater effort because of the coordination of several agencies (e.g. Bureau of Land Management, Washington State Department of Natural Resources, Washington State Department of Fish and Wildlife) and private land owners, all of whom have different philosophies on land management. It is also unlikely that the Forest Service will dedicate the entire Bonaparte block for bryophyte conservation. Geographic areas, therefore, do not appear to be the best way to break up bryophyte conservation efforts.

Further, biophysical environments do not offer clear results with which to guide conservation efforts. On the other hand, mesohabitats and bryophyte communities do show important patterns for land managers.

Some communities and mesohabitats show high fidelity to each other (Table 3-3). For example, wetlands most often support the *Leptodictyum humile* community and vice versa and cliffs most often support the *Pterigygnandrum filiforme* community. However, springs do not show an affinity to any community type while uplands make up the highest percentage of 5 different communities. Any one community type represents between three and five different mesohabitats. Doubt (2001) found similar results in her assessment of bryophytes in Waterton Lakes National Park in Alberta, Canada. The mesohabitats, based on geographic landforms, occur throughout the landscape and can exhibit high variability in their character. A stream, for example, can occur at low elevation with ephemeral stream flow with a rocky substrate bank or it can occur at high elevation with permanent water flow with an organic substrate bank. It makes sense that the low elevation stream may be more similar in bryophyte composition to a nearby upland or cliff than to the upper elevation stream. Thus the two environmental descriptors cannot accurately be used as correlates for one another.

The question thus emerges as to which one is better. Bryophyte community identification requires some site inventory as well as some experience in bryophyte identification. The mesohabitats, on the other hand, are readily identifiable landforms. Management based on mesohabitats thus emerges as the easiest approach to compartmentalizing the landscape for bryophyte conservation.

Conclusions

Sites with greater species richness will more likely contain rare species, but the sites of highest rarity values often do not correlate the highest richness values. Bryophyte richness is associated with high moisture, shallow slopes with less rock substrate, as well as with higher elevation and higher coniferous cover. Liverwort richness relies more heavily on moisture and will therefore be more susceptible to changes in water regime due to management practices. Bryophyte rarity does not correlate well with environmental parameters. Disturbance histories do not associate well with bryophyte richness and rarity due to high variability in disturbances through history as well as a lack of replication within this study. Classes of the mesohabitat, biophysical environment, bryophyte community and spatial area environmental descriptors exhibit differential patterns in richness and rarity and therefore do offer guidance with respect to conservation strategies for bryophyte conservation. The mesohabitats, however, emerge as the better choice to guide management decisions because they differentiate richness and rarity patterns well and do not require initial site inventory or specialized bryophyte identification skills.

Management Recommendations

- For the maintenance of bryophyte diversity in the study area, I recommend:
    - Conservation of the fourteen sites with high conservation value.
    - Conservation of representative sites in all habitats. Only 45% of the total gamma diversity occurred in any one class of the mesohabitats, biophysical environments, bryophyte communities and spatial areas. It will take conservation in all habitats to conserve the overall study area diversity.
- Conservations efforts for areas of richness and rarity may be guided (a coarse filter approach) by the following findings from this study:
    - Sites with higher richness may offer higher capture of species as well as higher likelihood of the presence of rare species.
    - Sites with higher habitat heterogeneity will offer higher species richness.
    - Fen and stream mesohabitats, the *Chiloscyphus pallescens* and *Pterigynandrum filiforme* bryophyte communities, and the Bonaparte block and the non-Forest Service lands hold greater importance for bryophyte richness and rarity than other classes in each environmental descriptor. Conservation for these habitats will protect more species for a given effort.
    - Mesohabitats emerge as the better coarse filter guide to bryophyte conservation strategies.
- Particular conservation concerns include:
    - Liverwort species are more closely tied to moisture regimes, so areas of high liverwort richness or particularly sites with rare liverwort species should be protected from changes in moisture levels that may be caused by management practices.

  - Livestock activity, more specifically trampling, has been associated with low occurrence of rare species, so areas currently protected from trampling, particularly if they contain rare species, should remain protected from livestock trampling.
- This study fell short in detecting and evaluating the effects of management histories on bryophyte richness and rarity. Further studies, designed to address the complicated factors associated with diverse management histories, are needed.

Table 3-1. Environmental descriptors with corresponding classes and definitions used as overlays in CCA ordinations and as grouping variables in analyses throughout the chapter.

Environmental Descriptor	Classes	Description
Mesohabitats		(physiographic landforms used to delineate sampling units)
	Fens	Moss-dominated wetlands
	Wetlands	Areas of seasonal or permanent wetness (ponds and wet meadows)
	Streams	Stream channel and bank within the influence (splash zone, high water line) of the water
	Springs	Areas of increased moisture (determined by vascular vegetation) in an upland matrix. Can be with or without water flow.
	Uplands	Forested or non-forested
	Cliffs	Vertical rock walls and associated ledges
	Talus slopes	Boulder/rock fields with intermixed soil patches
Biophysical Environments	Non-forest	(A temperature-moisture gradient, used by the U.S. Forest Service to compartmentalize management decisions (Lowe 1995). A description of each is given in the Study Area section of Chapter 2.)
	Riverine	
	Hot-dry	
	Warm-dry	
	Cool-dry	
	Cool-mesic	
	Cold-mesic	
	Cold-dry	
	Subalpine	

Table 3-1 (continued)

Environmental Descriptor	Classes	Description
Bryophyte Communities	*Chiloscyphus pallescens* *Leptodictyum humile* *Brachythecium erythrorrhizon* *Rhytidiopsis robusta* *Tritomaria exectiformis* *Pterigynandrum filiforme* *Bryum argenteum*	(Determined by TWINSPAN analysis in PC-ORD version 4.17 (McCune and Mefford 1999). See Table 3-3 for indicator and preferential species.)
Fire Histories		Determined from GIS database at the U.S. Forest Service in addition to presence of fire scars at the sites:
	None	No fires scars, not in a fire polygon in GIS database.
	Moderate	Less than 50% fire scars present at site.
	High	More than 50% fire scars present at site, or within a fire polygon in GIS database (some sagebrush sites did not have any charred remains, but were obviously affected by the fire).
Logging Histories		Determined from GIS database at the U.S. Forest Service in addition to presence of stumps in the sites:
	None	No disturbance from logging noted, or logging (selective cut) occurred around 1900 in the GIS database (only 4 sites). Stands mature.
	Moderate	Logging occurred between 1940 and 1970 (overstory removal or selective cut) in GIS database. Relatively mature stand with stumps.

Table 3-1 (continued)

Environmental Descriptor	Classes	Description
Logging History (continued)	Heavy	Logging has occurred since 1970 (clearcut or seed tree/shelterwood cut). Sites with low canopy cover and areas of disturbed soil.
Livestock Activities		Assessed at sites:
	None	No grazing evident, no pies.
	Light	Light grazing, few pies.
	Moderate	Moderate grazing, several pies.
	Heavy	Short stubble, bank degradation in streams and wetlands, lots of pies.
Spatial Areas	Non-Forest Service Lands Mt. Hull Block Bonaparte Block East Block	(Determined by grouping contiguous geographic areas. Areas are shown on Figure 3-1.)

Table 3-2. Twenty-five environmental variables recorded in all sites in study area. The measurement methodologies are given. Codes apply to environmental variables used in CCA ordinations.

Environmental variable (units, if applicable)	Code	Measurement method
Slope (degrees)	SLOPE	Clinometer sighting between two researchers. Five random samples[1] taken and averaged.
Elevation (meters (feet) above sea level)	ELEV	Garmin 12XL handheld GPS unit used.
Aspect (degrees)	NORTHING EASTING	Compass used to determine main direction of slope. Aspect readings were transformed into northing (cos(aspect)) and easting(sin(aspect)) variables for CCA ordinations (Roberts 1986).
Cover of soil	SOIL	Visual estimate (cover class[2]).
Cover of rock	ROCK	Visual estimate (cover class[2]).
Cover of water	WATER	Visual estimate (cover class[2]).
Texture of soil	TEXT	Tactile estimate on arbitrary 3-point scale from fine (1) to coarse (3).
Rock roughness	ROUGH	Tactile estimate of the rock roughness (like sandpaper roughness) on arbitrary 5-point scale from smooth (1) to coarse (5).
Rock microtopography	MICROT	Visual estimate of the rock relief on an arbitrary 5-point scale from smooth (1) to coarse (5).
Substrate stability	STABLE	Estimate of the stability of the substrate on an arbitrary 5-point scale from very stable (1) to actively eroding (5).
Litter thickness (cm)	LIT_THICK	Ruler measurement of the litter layer thickness. Five random samples[1] taken and averaged.
Cover of litter	LIT_COV	Visual estimate (cover class[2]).

Table 3-2 (continued)

Environmental variable (units, if applicable)	Code	Measurement method
Litter type	LIT_TYPE	Litter types noted in field and converted to an arbitrary 3-point scale including herbaceous (1), coniferous (3) and both (2).
Moisture	MOIST	Estimate of the overall moisture at the site on an arbitrary 5-point scale from very dry (1) to very wet (5).
Percent organic matter content of soil	ORGANIC	Soil sample taken from each site, dried, homogenized, weighed, burned in a Thermolyne 62700 Furnace at 550°C and reweighed to calculate the percent of organic carbon lost on ignition (Heiri et al. 2001).
Percent inorganic carbon content of soil	INORGAN	Soil sample taken from each site and processed for organic matter content. Soil burned again at 950°C in a Thermolyne 62700 Furnace and reweighed to calculate the percent of inorganic carbon lost on ignition (Heiri et al. 2001).
Soil pH	PH_SOIL	Soil sample taken from each site, dried, homogenized and sifted. Soil slurries were made with a $CaCl_2$ solution and pH was measured using a Fisher Scientific Accumet Portable Laboratory or a Beckman Φ45 pH Meter (Kalra & Maynard 1991).
Cover of down woody debris	DWD_COV	Visual estimate (cover class[2]) of all woody substrates on the ground.
Overall canopy cover	DENSIO	Handheld concave densiometer used to estimate overall canopy cover. Five random samples[1] taken and averaged.
Cover of coniferous trees	CON_COV	Visual estimate (cover class[2]).

Table 3-2 (continued)

Environmental variable (units, if applicable)	Code	Measurement method
Cover of deciduous trees	DEC_COV	Visual estimate (cover class[2]).
Cover of shrubs	SHRUB_COV	Visual estimate (cover class[2]).
Cover of herbaceous plants	HERB_COV	Visual estimate (cover class[2]).
Cover of bryophytes	BRYO_COV	Visual estimate (cover class[2]).
Habitat heterogeneity	HAB_HET	Count of the number of microhabitats (see Table 2) available at each site.

[1] Randomization technique: The researcher would start at one side of the designated sample area and take one set of recordings. He/she would walk a random number (from a random number chart) of paces and take the recordings again. Another random number would designate which direction (odd-left, even-right) to walk another random number of paces to take the third set of recordings. The researcher would return to the second point and continue along the original line of travel a random number of paces to take a fourth set of recordings. He/she would repeat the process to go either right or left to take the last set of recordings.

[2] Cover classes were used to ease the estimation of percent cover of certain variables. The cover classes were designated as follows: 0 = 0%, 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, 4 = 51-75%, 5 = 76-90% and 6 = 91=100%.

Table 3-3. TWINSPAN communities with corresponding preferential species. The numbers represent the frequency of each mesohabitat type that occurred in each bryophyte community type. Bolded numbers represent the largest representative in each mesohabitat category. Underlined numbers represent the largest representative in each Community. Those that are bolded and underlined, therefore, show the highest fidelity between mesohabitat and community.

Community	Mesohabitat Category						
	Fen	Wet-land	Stream	Spring	Up-land	Cliff	Talus slope
Chiloscyphus pallescens *Lepidozia reptans* *Lophozia incisa* *Plagiochila porelloides* *Riccardia latifrons*	**6**	3	**10**	1			
Leptodictyum humile *Bryum argenteum* *Dicranella schreberiana* var. *robusta*	1	**16**	3	1	4		
Brachythecium erythrorrhizon *Lescuraea radicosa* *Pohlia wahlenbergii*		1	3	3	5	1	
Rhytidiopsis robusta *Ptilium crista-castrensis* *Dicranum scoparium* *Brachythecium hylotapetum* *Brachythecium leibergii*			1		13		1
Tritomaria exectiformis *Funaria hygrometrica*		1		1	8		2
Pterigynandrum filiforme *Hypnum revolutum* *Dicranum scoparium* *Brachythecium collinum* *Dicranoweisia crispula*		2	1		9	**9**	**4**
Bryum argenteum *Tortula bartramii* *Grimmia alpestris* *Didymodon brachyphyllus*			3	3	**16**	6	3

Table 3-4. Summary statistics of Canonical Correspondence Analysis of all sites in the study area. The total inertia for the CCA ordination was 0.5361.

	Axis 1	Axis 2	Axis 3
Eigenvalue	0.277	0.066	0.017
Percent variance explained	42.3	12.2	3.2
Cumulative percent variance explained	42.3	54.6	57.7
Species-Environment Correlation (Pearson)	0.910	0.888	0.694

Table 3-5. Correlation between 26 environmental variables and CCA LC scores (intraset correlations) along the first three ordination axes. Variable names follow Table 3-2 and the arc- and log- prefixes refer to arcsine and logarithmic transformations, respectively. An asterisk indicates significance at the $p < 0.05$ level ($r = 0.164$, df = 139, $p = 0.05$).

Environmental Variable	Axis 1	Axis 2	Axis 3
logSLOPE	0.653*	-0.543*	0.250*
ELEV	-0.293*	-0.540*	0.046
arcNORTHING	0.180*	-0.062	0.130
arcEASTING	-0.055	0.141	-0.227*
SOIL	-0.428*	-0.039	-0.597*
logROCK	0.655*	-0.301*	0.398*
logWATER	-0.579*	0.538*	0.141
TEXT	-0.226*	0.146	0.023
ROUGH	0.246*	-0.167*	0.135
MICROT	0.483*	-0.036	0.470*
STABLE	0.375*	-0.098	0.163
logLIT_THICK	-0.026	-0.131	0.013
LIT_COV	-0.254*	-0.327*	-0.165*
LIT_TYPE	0.007	-0.562*	-0.028
MOIST	-0.855*	0.322*	0.180*
logORGANIC	-0.528*	-0.095	0.224*
logINORGAN	-0.139	0.441*	0.296*
PH_SOIL	0.163	0.570*	0.131
logDWD_COV	-0.381*	-0.409*	-0.094
DENSIO	-0.425*	-0.417*	0.221*
logCON_COV	-0.334*	-0.755*	0.107
logDEC_COV	-0.347*	0.188*	0.114
logSHRUB_COV	0.052	-0.129	-0.243*
HERB_COV	-0.390*	0.373*	-0.263*
logBRYO_COV	-0.559*	0.044	0.291*
HAB_HET	-0.353*	-0.418*	0.019

Table 3-6. Matrix with the number of sites that occur in each combination of three richness categories and three rarity categories. Bolded numbers represent fourteen sites that exhibit high conservation value.

	Richness 1 Sites with 1-22 species N=50	**Richness 2** Sites with 23-44 species N=77	**Richness 3** Sites with 45-66 species N=14
Rarity 1 Sites with 0-1 rare species N=112	44	60	8
Rarity 2 Sites with 2-3 rare species N=19	5	9	**5**
Rarity 3 Sites with 4-7 rare species N=10	1	**8**	**1**

Table 3-7. Comparison of fourteen sites with the highest conservation value (determined in Table 3-5) with respect to their distribution between the classes of the four environmental descriptors. Definitions of descriptors with corresponding classes follow Table 3-2.

Environmental Descriptor/ Class	**Number of Sites**	**Environmental Descriptor/ Class**	**Number of sites**
Mesohabitats		**Biophysical Environments**	
Fens	4	Riverine	1
Streams	5	Non-forest	2
Wetlands	1	Hot-dry	1
Springs	0	Warm-dry	1
Uplands	3	Cool-dry	3
Cliffs	1	Cool-mesic	2
Talus slopes	0	Cold-mesic	2
		Cold-dry	1
Bryophyte Communities		Subalpine	0
Chiloscyphus pallescens	7		
Leptodictyum humile	2	**Spatial Areas**	
Brachythecium erythrorrizon	1	Non-Forest Service	5
Rhytidiopsis robusta	1	Mt. Hull Block	0
Tritomaria exectiformis	0	Bonaparte Block	9
Pterigynandrum filiforme	3	East Blocks	0
Bryum argenteum	0		

Table 3-8. Gamma diversity, percent of total gamma diversity and number of unique species for each of the classes of the mesohabitat, biophysical environment, bryophyte community and spatial area environmental descriptors. Gamma diversity for all 141 sites is 266.

Environmental Descriptor	N	Group Gamma Diversity (Percent of Total)	Unique Species
Mesohabitat			
Fens	7	116 (43.6)	23
Wetlands	23	125 (47.0)	4
Streams	21	152 (57.1)	21
Springs	9	105 (39.4)	3
Uplands	55	167 (62.8)	25
Cliffs	16	113 (42.5)	9
Talus slopes	10	70 (26.3)	2
Biophysical Environment			
Riverine	5	42 (15.7)	6
Non-forest	19	113 (42.5)	7
Hot-dry	16	84 (31.6)	4
Warm-dry	28	151 (56.8)	18
Cool-dry	23	154 (57.9)	8
Cool-mesic	24	155 (58.3)	5
Cold-mesic	19	135 (50.8)	5
Cold-dry	6	99 (37.2)	18
Subalpine	1	16 (6.0)	1
Bryophyte Community			
Chiloscyphus pallescens	20	160 (60.2)	32
Leptodictyum humile	25	117 (44.0)	11
Brachythecium erythrorrhizon	13	107 (40.2)	8
Rhytidiopsis robusta	15	96 (36.1)	3
Tritomaria exectiformis	12	89 (33.4)	3
Pterigynandrum filiforme	25	145 (54.5)	13
Bryum argenteum	31	97 (36.5)	11
Spatial Area			
Non-Forest Service	41	158 (59.4)	29
Mt. Hull block	16	131 (49.2)	11
Bonaparte block	71	214 (80.5)	44
East blocks	13	132 (49.6)	5

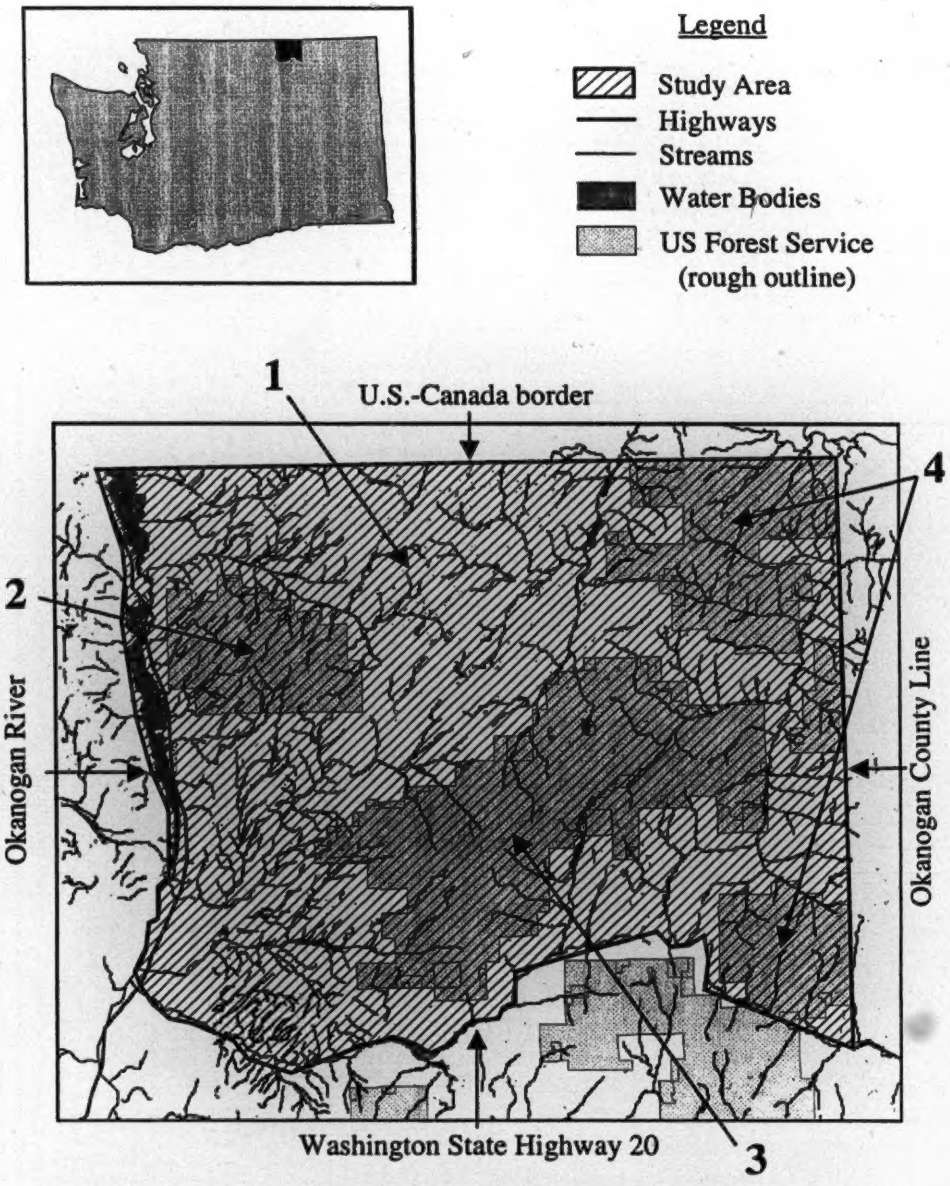

Legend
Study Area
Highways
Streams
Water Bodies
US Forest Service (rough outline)
1
U.S.-Canada border
2
4
Okanogan River
Okanogan County Line
Washington State Highway 20
3

Figure 3-1. Map of study area located in north-central Washington State, U.S.A. The study area borders British Columbia, Canada to the north, the Okanogan County Line to the east, Washington State Highway 20 to the south and the Okanogan River to the west. Four regions for spatial analysis are shown : 1 - Non-Forest Service lands (all non-Forest Service areas depicted in white), 2 - Mt. Hull Block, 3 - Bonaparte Block and 4- East Blocks.

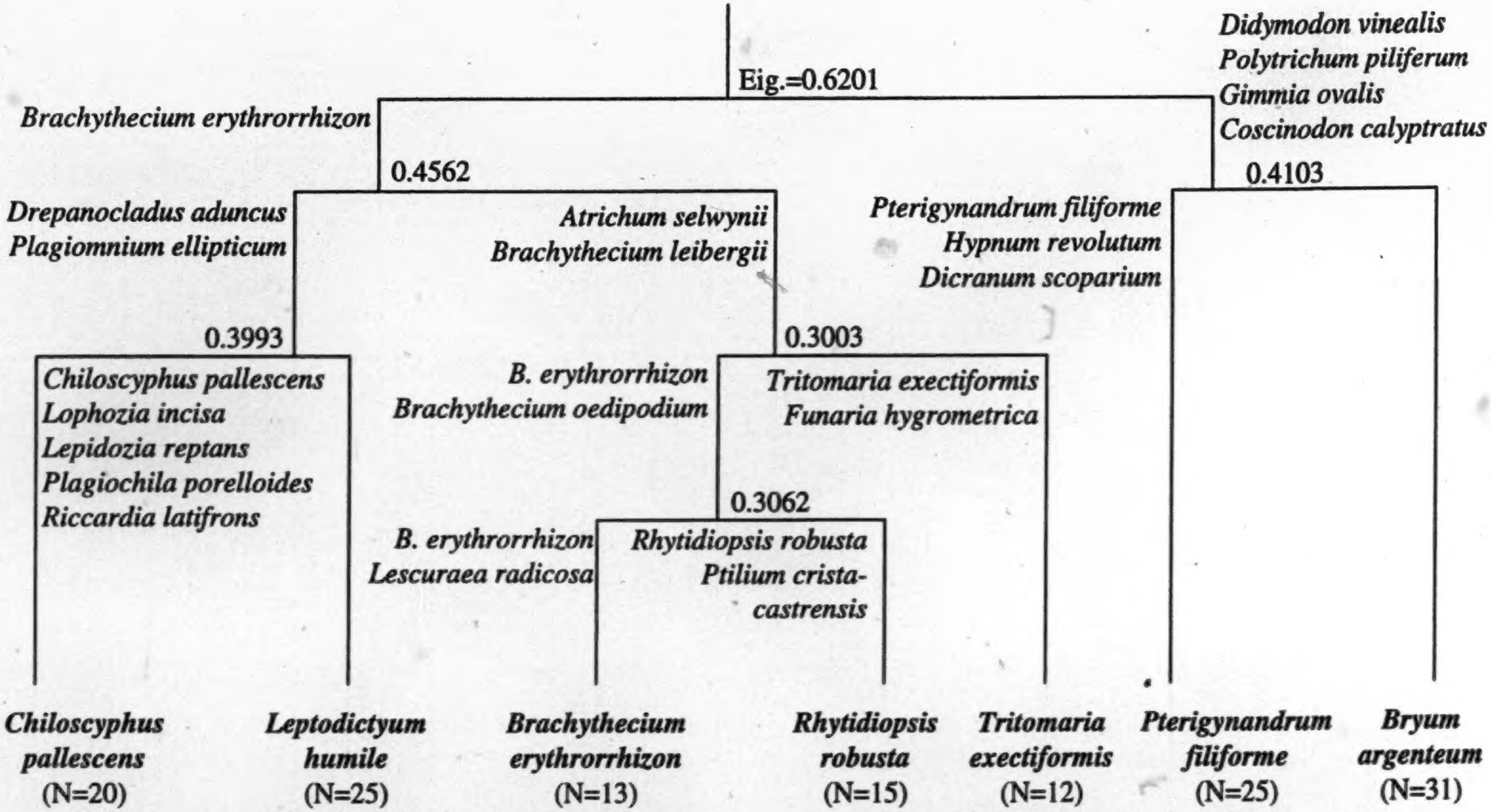
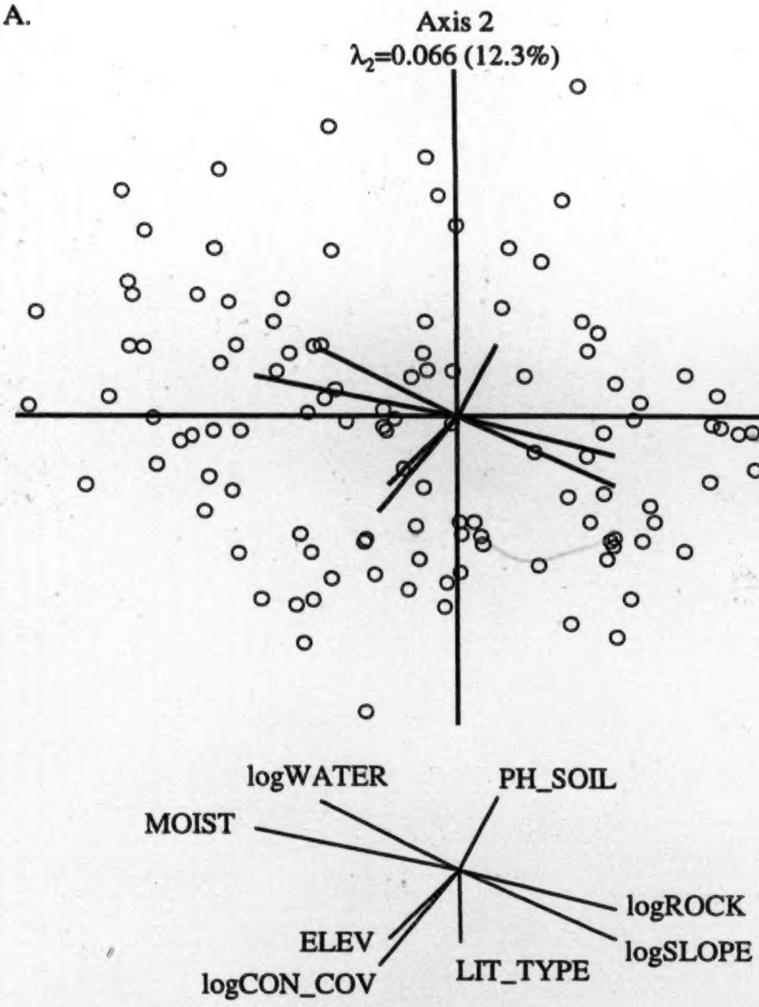

Eig.=0.6201
Brachythecium erythrorrhizon
Didymodon vinealis
Polytrichum piliferum
Gimmia ovalis
Coscinodon calyptratus
0.4562
0.4103
Drepanocladus aduncus
Plagiomnium ellipticum
Atrichum selwynii
Brachythecium leibergii
Pterigynandrum filiforme
Hypnum revolutum
Dicranum scoparium
0.3993
0.3003
Chiloscyphus pallescens
Lophozia incisa
Lepidozia reptans
Plagiochila porelloides
Riccardia latifrons
B. erythrorrhizon
Brachythecium oedipodium
Tritomaria exectiformis
Funaria hygrometrica
0.3062
B. erythrorrhizon
Lescuraea radicosa
Rhytidiopsis robusta
Ptilium crista-castrensis
Chiloscyphus pallescens (N=20)
Leptodictyum humile (N=25)
Brachythecium erythrorrhizon (N=13)
Rhytidiopsis robusta (N=15)
Tritomaria exectiformis (N=12)
Pterigynandrum filiforme (N=25)
Bryum argenteum (N=31)

Figure 3-2. TWINSPAN dendrogram showing classification of bryophyte communities for all sites. The numbers at each dendrogram division represent the corresponding eigenvalues. Indicator species are listed at each division. Community names, based on indicator or preferential species, are listed at the base with each group size. A list of the preferential species for each community type as well as the represented mesohabitats of each community type can be found in Table 3-3.

A.

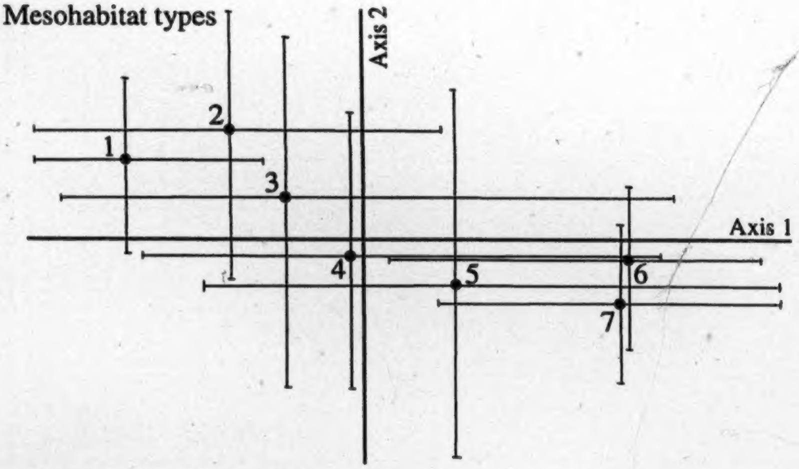


(r^2 cutoff = 0.300)

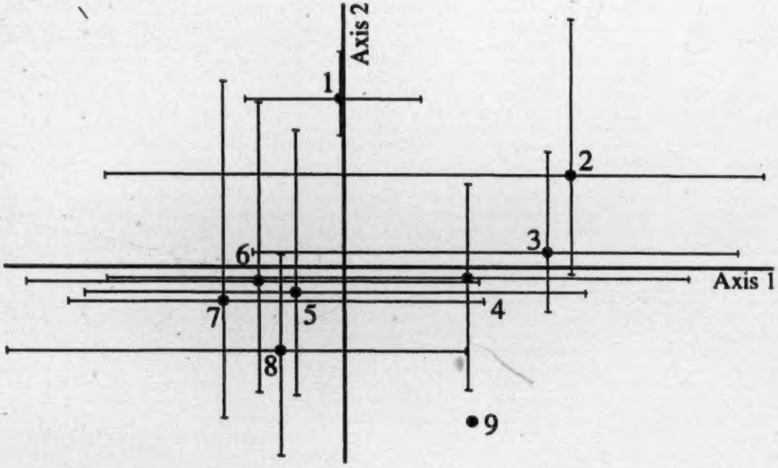
Figure 3-3A-M. A. Distance biplot for a CCA ordination of 141 sites against 26 environmental variables. The total inertia for the CCA was 0.5361. Numbers in parantheses represent the percent variation in the species data explained by each axis. The centroids and ranges are displayed for the following environmental descriptors: B. mesohabitats, C. biophysical environments, D. bryophyte communities, E. fire histories, F. livestock activities and G. logging histories. The biplot was overlaid with H. total bryophyte richness, I. moss richness, J. liverwort richness, K. number of rare bryophytes, L. number of rare mosses and M. number of rare liverworts at each site. The size of circle represents a relative number of species in each site. Definitions of environmental descriptor classes follow Table 3-1 and environmental variable names follow Table 3-2. The arc- and log- prefixes refer to arcsine and logarithmic transformations, respectively.

Figure 3-3 (continued)

B. Centroids of Mesohabitat types



C. Centroids of Biophysical Environments



D. Centroids of Bryophyte Communities

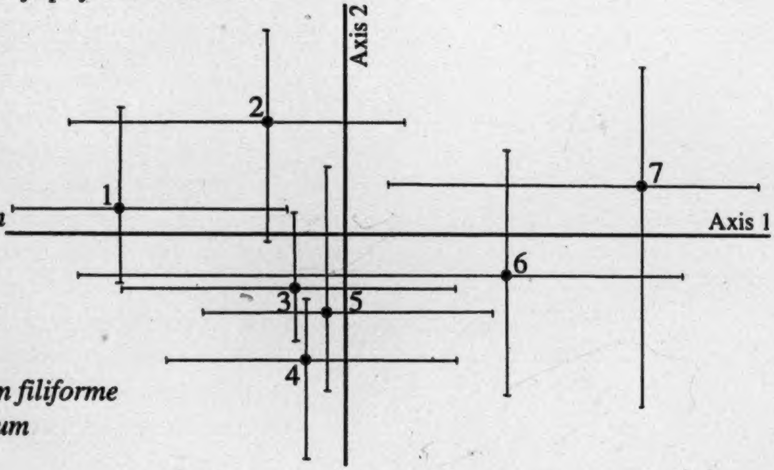
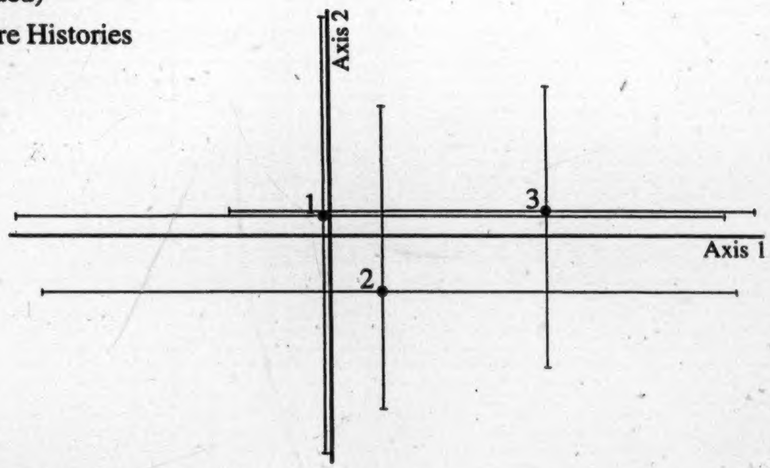


Figure 3-3 (continued)

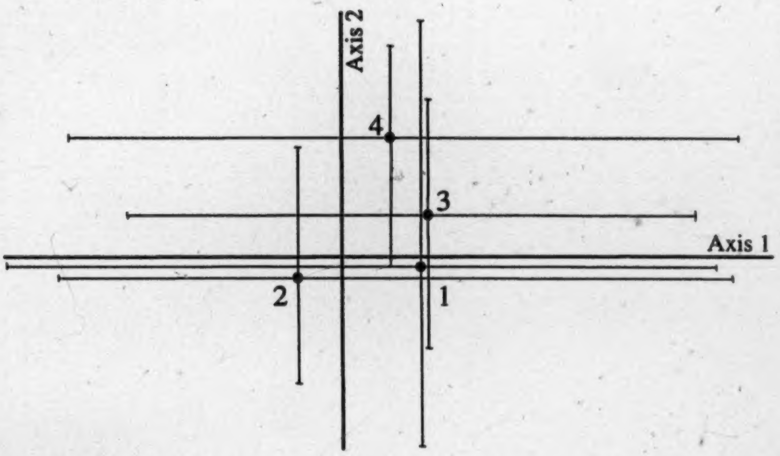
E. Centroids of Fire Histories

1 None
2 Moderate
3 High



F. Centroids of Livestock Activity

1 None
2 Light
3 Moderate
4 Heavy



G. Centroids of Logging Histories

1 Non-forest, not applicable
2 None
3 Moderate
4 High

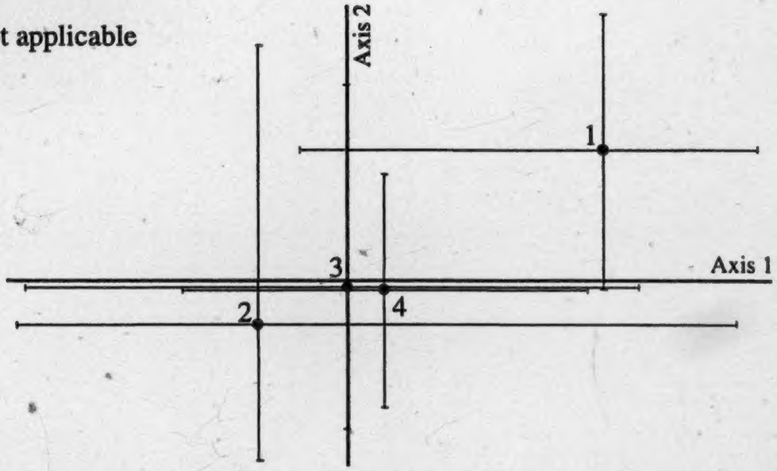
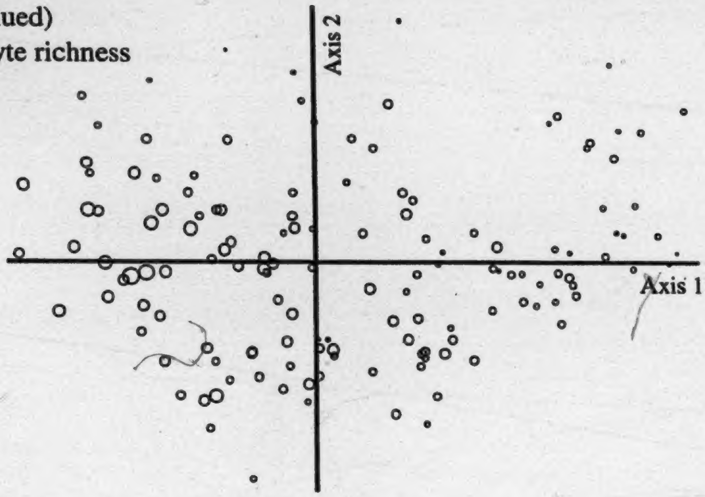
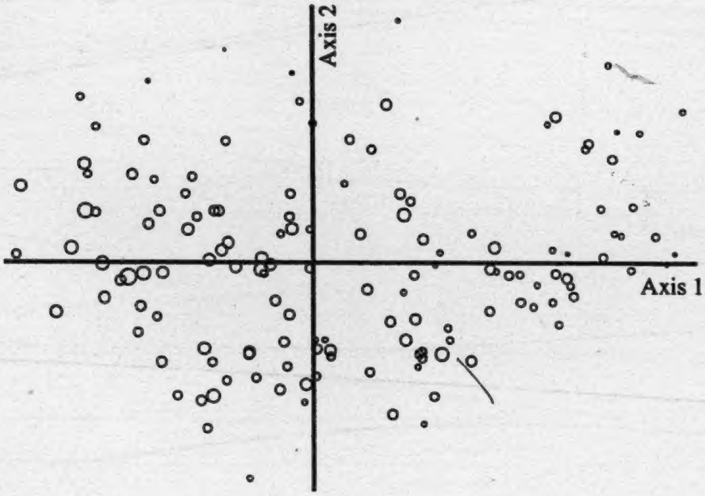


Figure 3-3 (continued)

H. Total bryophyte richness



I. Moss richness



J. Liverwort richness

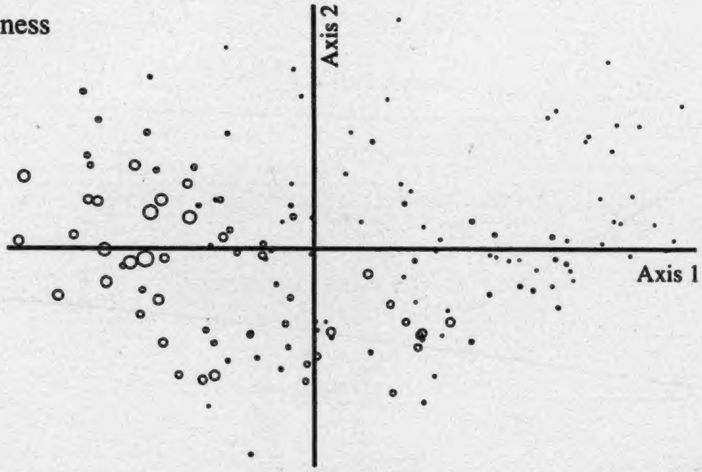
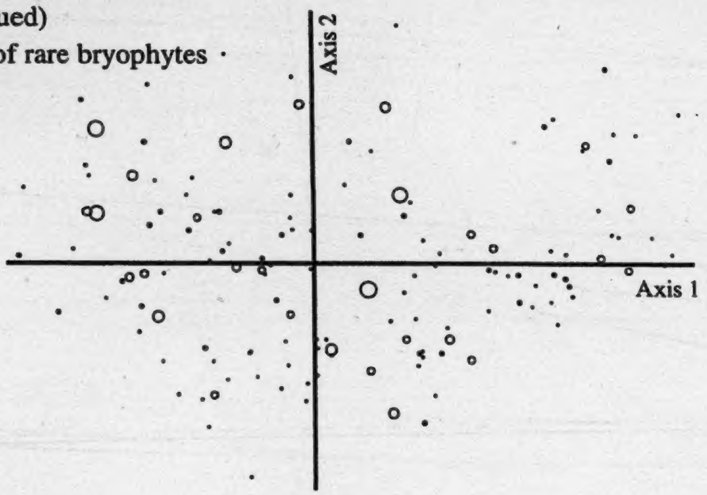
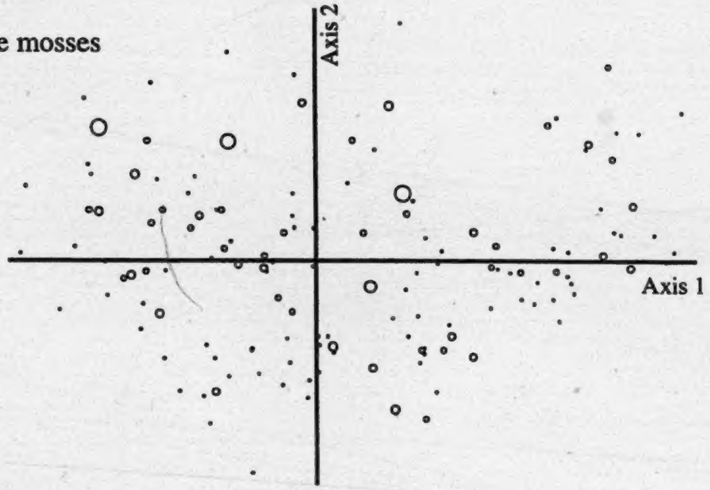


Figure 3-3 (continued)

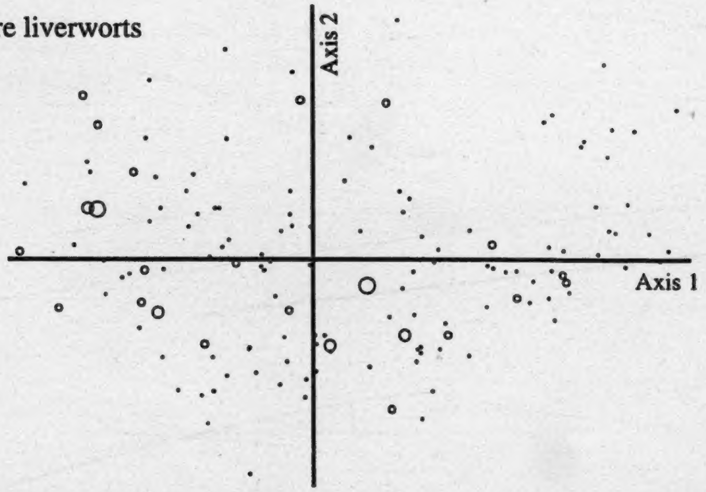
K. Total number of rare bryophytes



L. Number of rare mosses



M. Number of rare liverworts



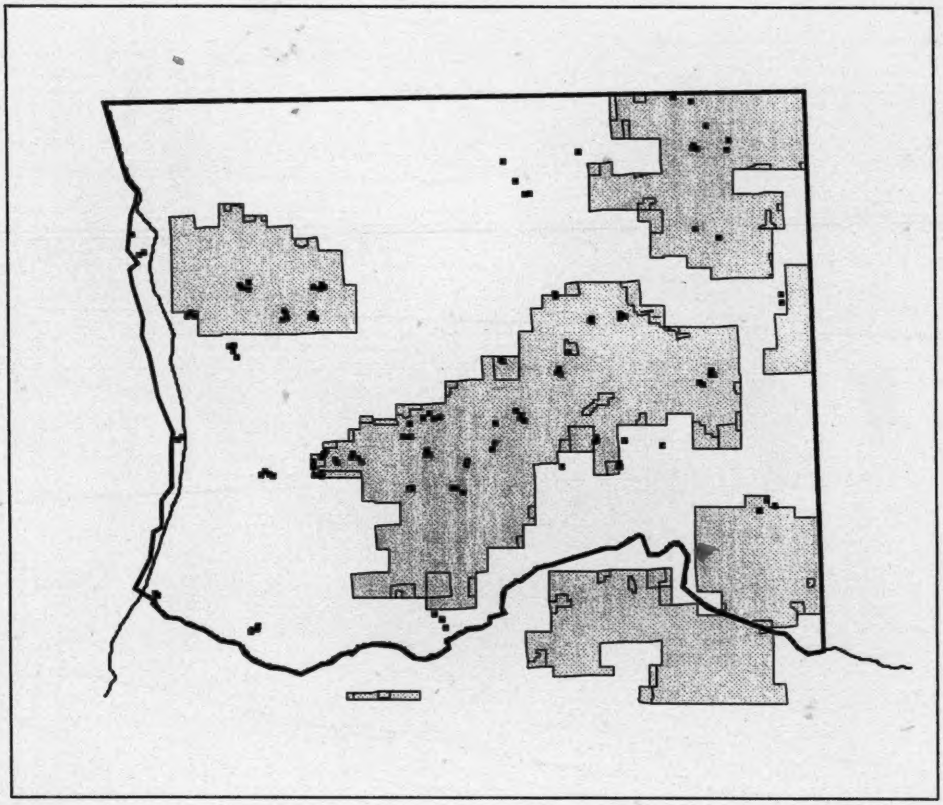
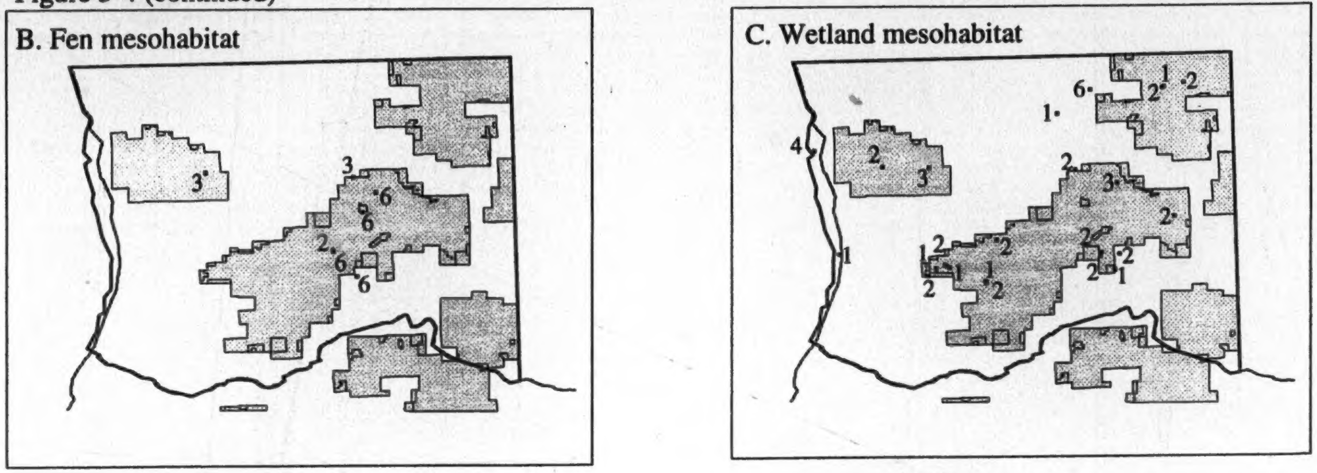


Figure 3-4A-X. A. Study area with all 141 sites displayed to show overall spatial distribution of sites. Site conservation values, the product of site richness value and site rarity value (Table 3-6), are shown for the seven mesohabitats (B-H), nine biophysical environments (I-Q), and seven bryophyte communities (R-X) by a numerical score (values of 1, 2, 3, 4, 6, 9). Low values indicate low site conservation value and high values indicate high site conservation value.

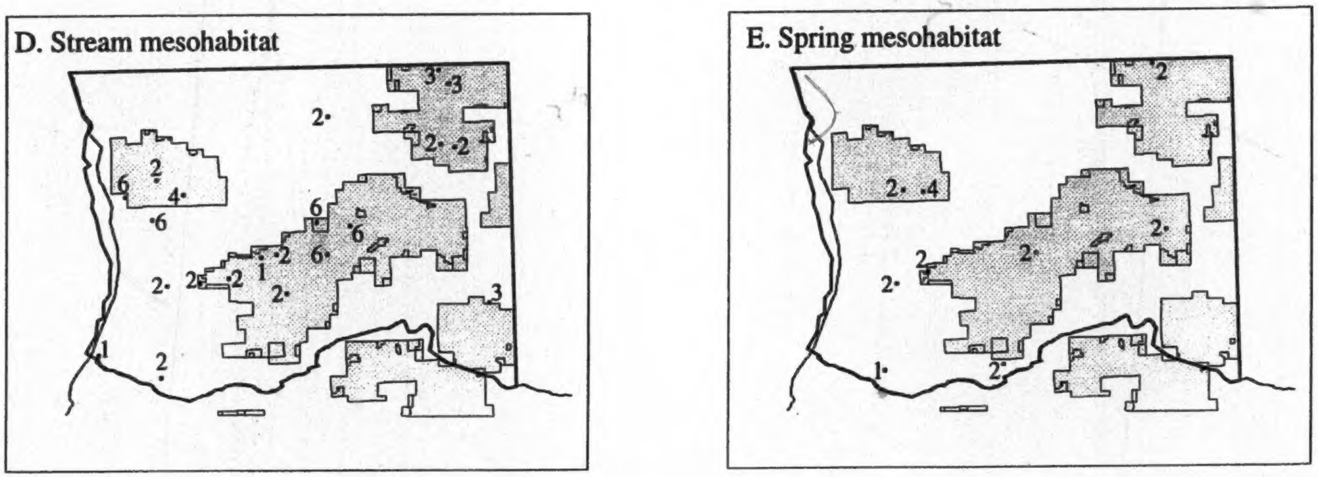
Figure 3-4 (continued)



B. Fen mesohabitat

C. Wetland mesohabitat

3
3
6
6
2
6
6
4
2
3
1
6
1
2
1
2
2
3
2
2
1
2
1
2
2
1
2
2
1



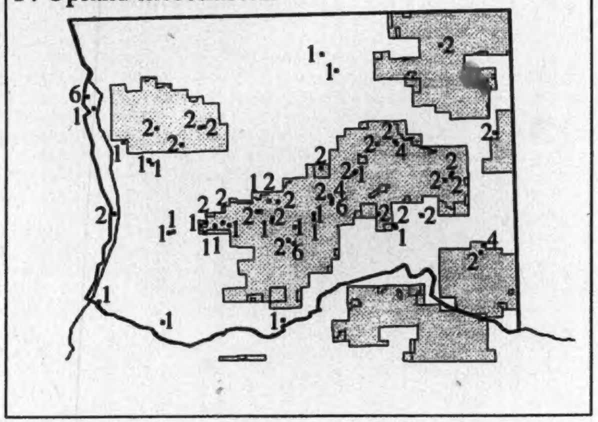
D. Stream mesohabitat

E. Spring mesohabitat

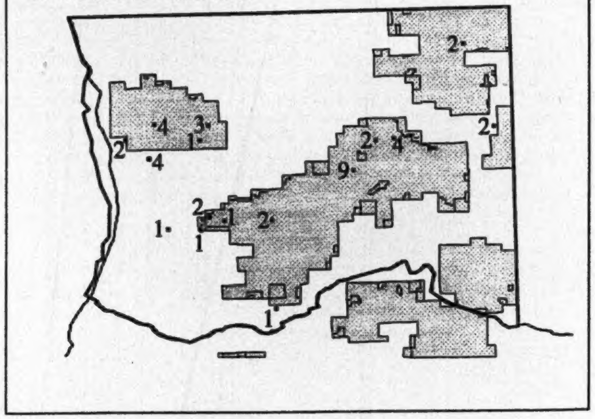
3
3
2
2
2
2
6
4
6
6
6
2
6
2
1
2
2
2
3
1
2
2
2
4
2
2
2
2
1
2

Figure 3-4 (continued)

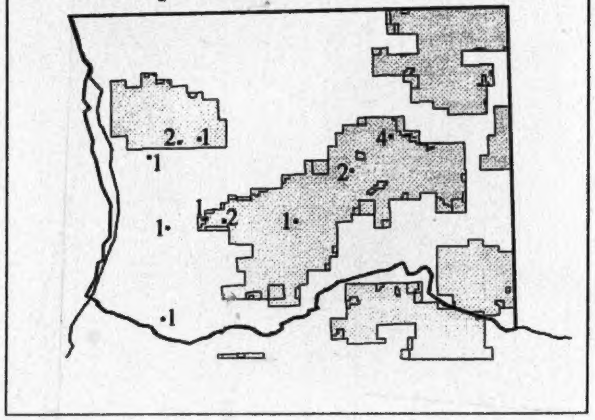
F. Upland mesohabitat



G. Cliff mesohabitat



H. Talus slope mesohabitat



I. Riverine Biophysical Environment

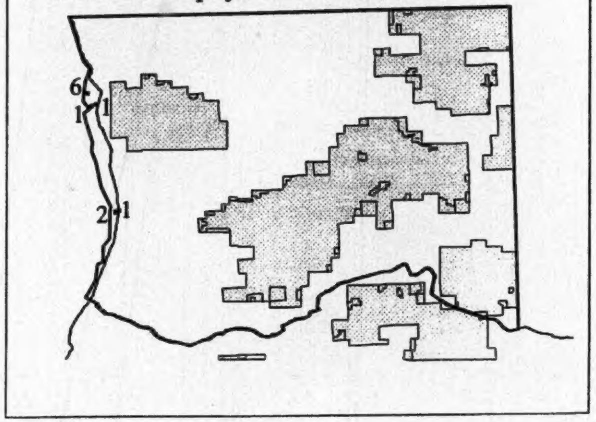
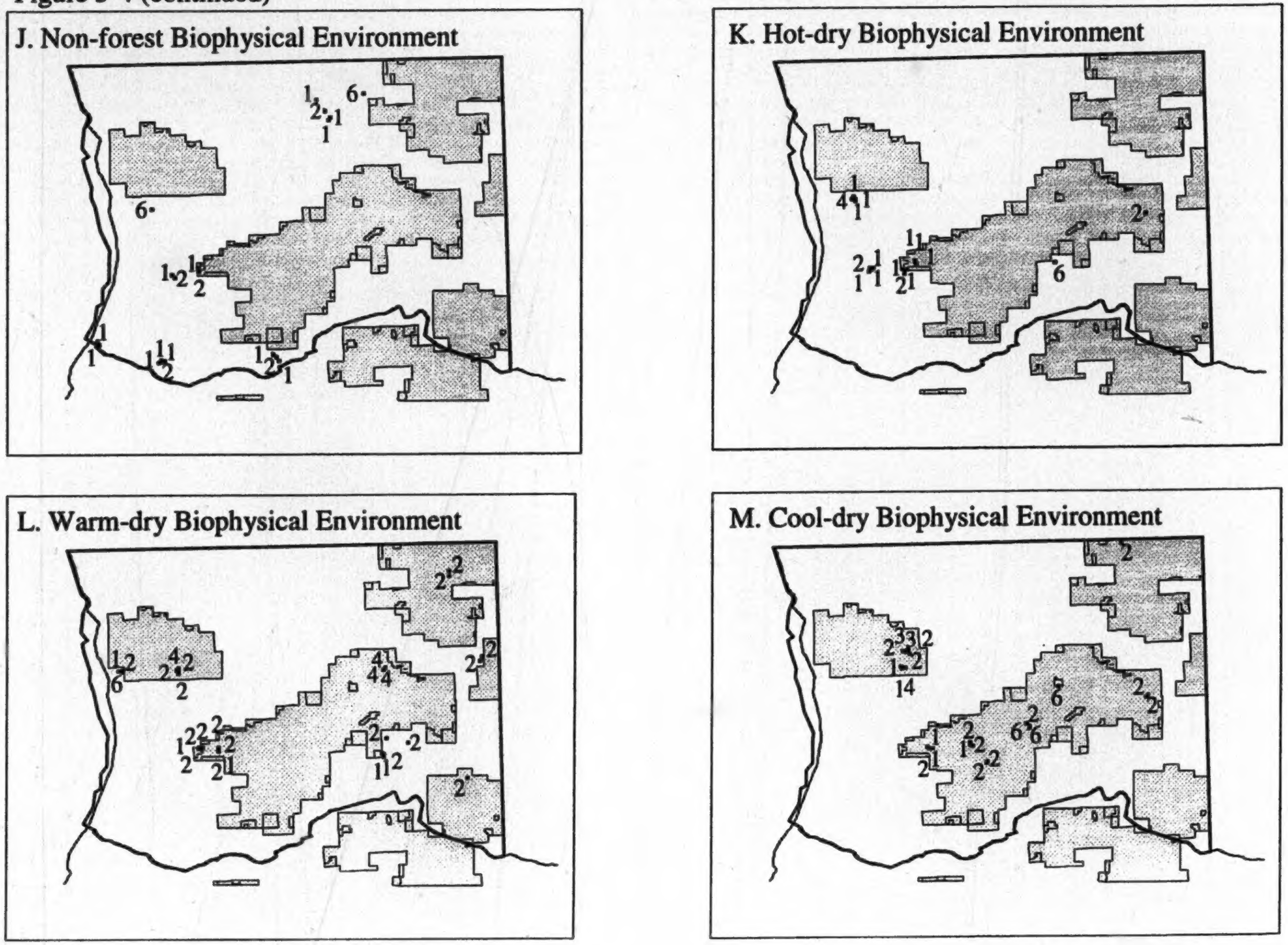


Figure 3-4 (continued)



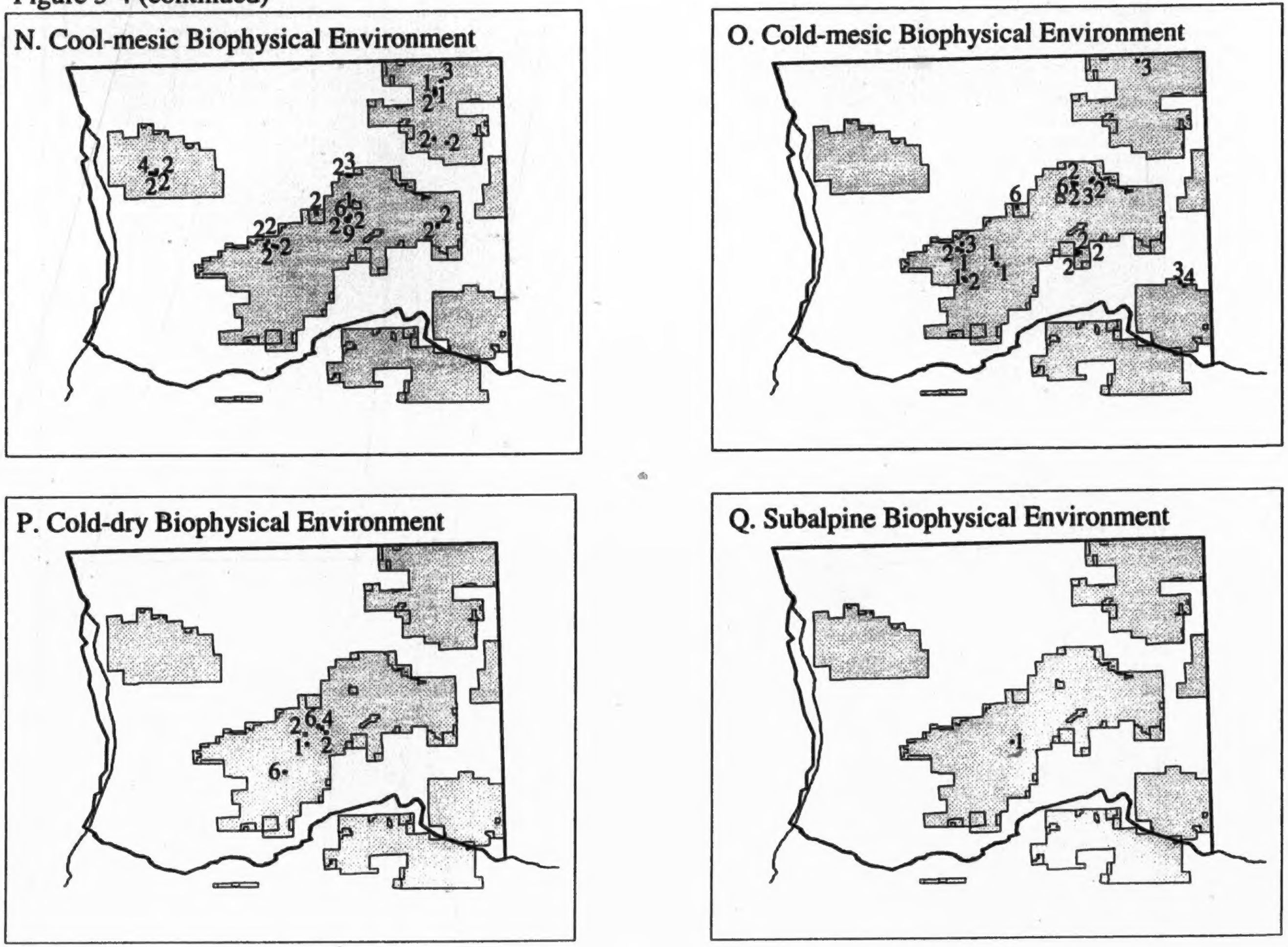
J. Non-forest Biophysical Environment

K. Hot-dry Biophysical Environment

L. Warm-dry Biophysical Environment

M. Cool-dry Biophysical Environment

Figure 3-4 (continued)



N. Cool-mesic Biophysical Environment

O. Cold-mesic Biophysical Environment

P. Cold-dry Biophysical Environment

Q. Subalpine Biophysical Environment

4
2
22
23
22
2
2
2
6
1
2
29
2
1
3
2
1
2
2
2
3
6
2
6
2
3
2
2
3
1
1
2
1
1
2
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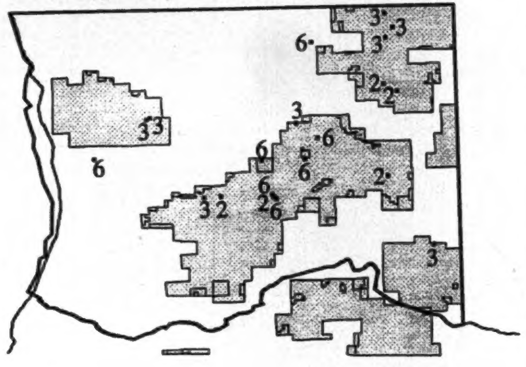
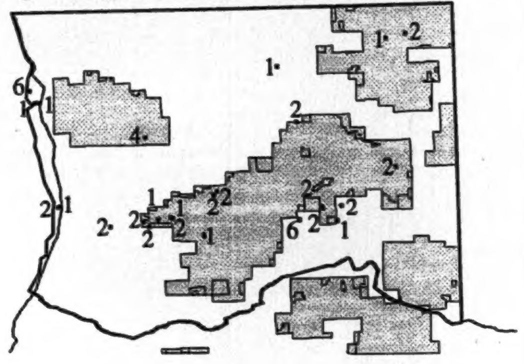
1
2
6
1

Figure 3-4 (continued)

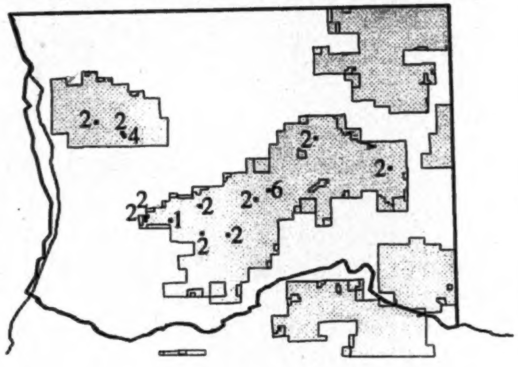
R. *Chiloschyphus pallescens* Community



S. *Leptodictyum humile* Community



T. *Brachythecium erythrorrhizon* Community



U. *Rhytidiopsis robusta* Community

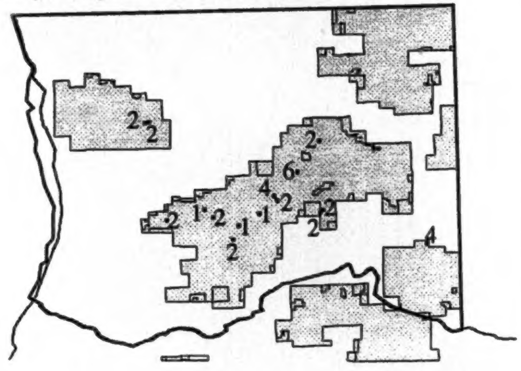
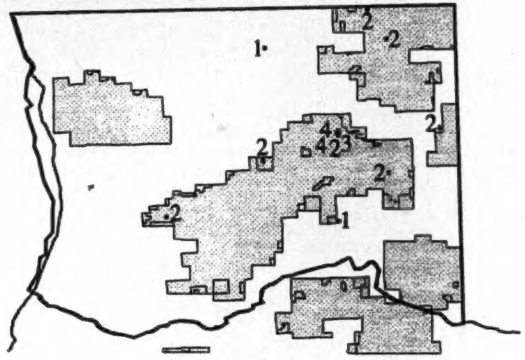
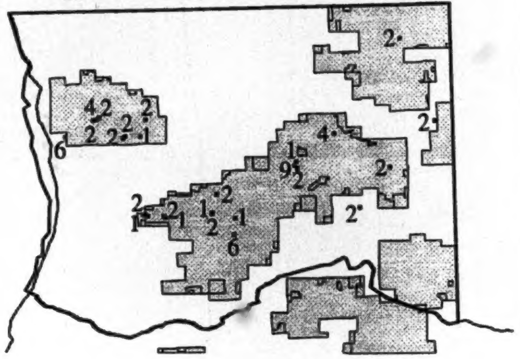


Figure 3-4 (continued)

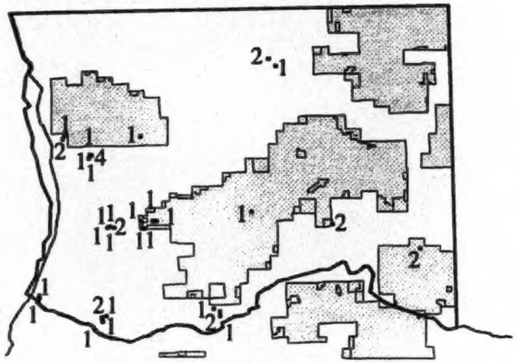
V. *Tritomaria exectiformis* Community



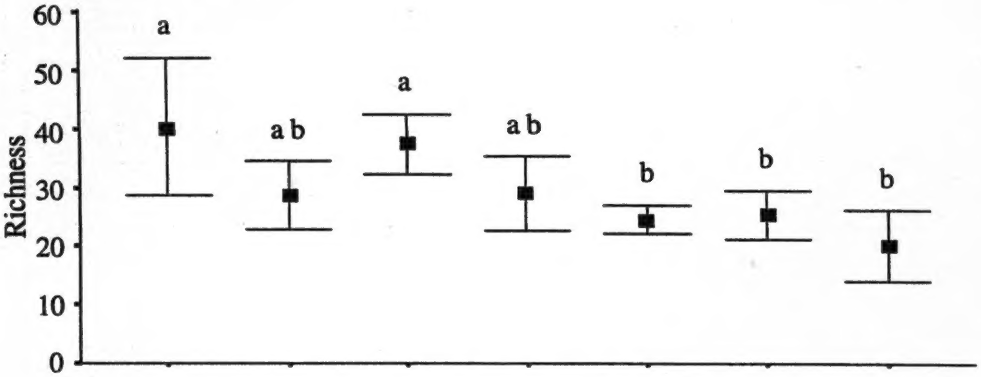
W. *Pterigynandrum filiforme* Community



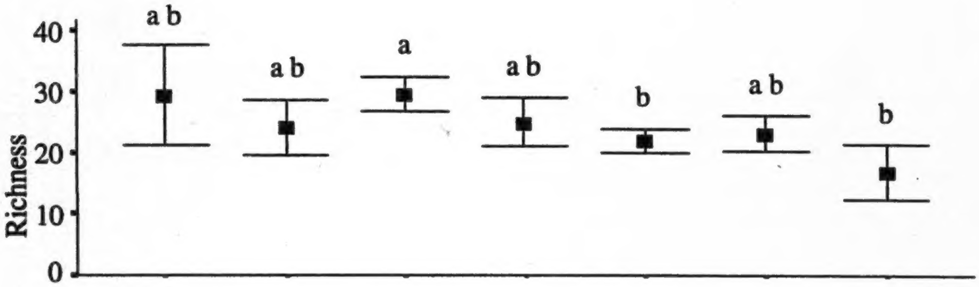
X. *Bryum argenteum* Community



A. Bryophyte richness



B. Moss richness



C. Liverwort richness

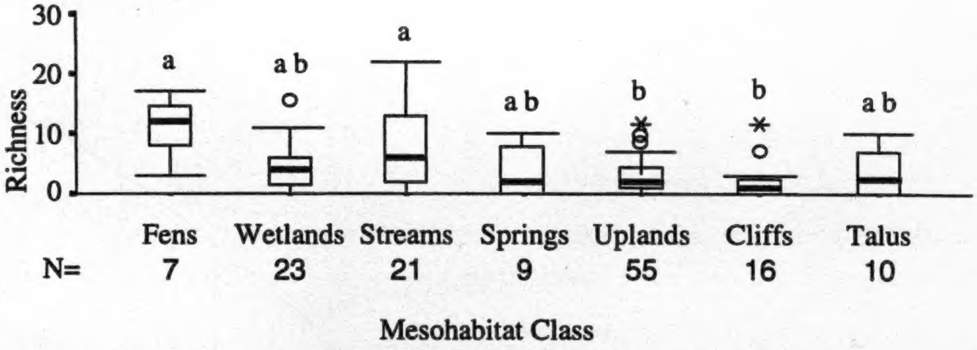


Figure 3-5A-C. Comparison of species richness for seven mesohabitat classes for the following three species groups: A. Total bryophyte richness (mean +/- 2 SE), B. Moss richness (mean +/- 2 SE) and C. Liverwort richness (box-whisker plot: box indicates interquartile range, bold horizontal line indicates the median, the whiskers represent the range excluding the outliers, the circles indicate outliers within 3 box lengths of the edge of the box and the asterisks indicate extreme values greater than 3 box lengths from the edge of the box (SPSS Inc 2001)).

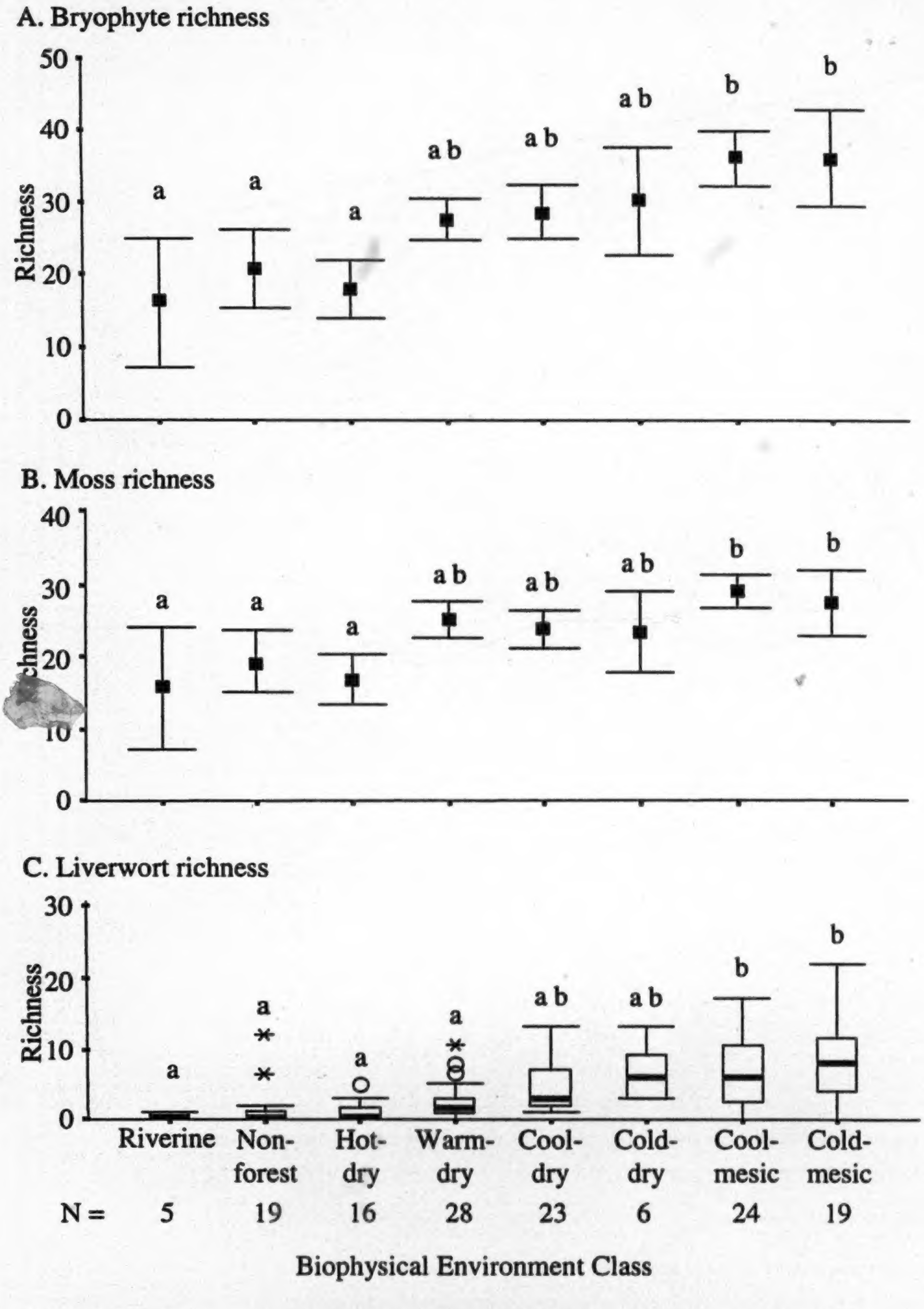


Figure 3-6A-C. Comparison of species richness for eight biophysical environment classes for the following three species groups: A. Total bryophyte richness (mean +/- 2 SE), B. Moss richness (mean +/- 2 SE) and C. Liverwort richness (box-whisker plot: see description on Figure 3-5)

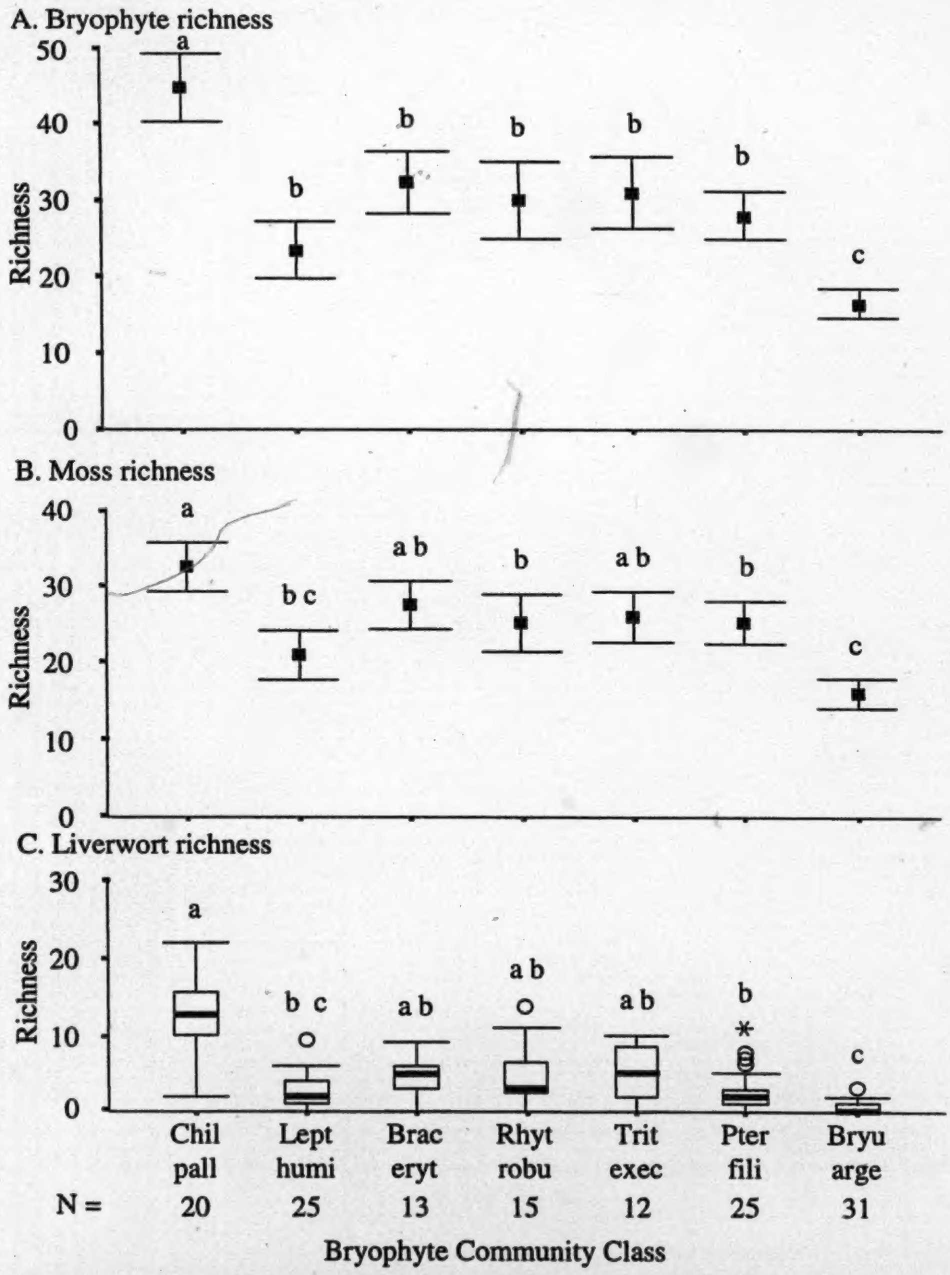


Figure 3-7A-C. Comparison of species richness for seven bryophyte community classes for the following three species groups: A. Total bryophyte richness (mean +/- 2 SE), B. Moss richness (mean +/- 2 SE) and C. Liverwort richness (box-whisker plot: see description on Figure 3-5). Chil pall = *Chiloscyphus pallescens*, Lept humi = *Leptodictyum humile*, Brac eryt = *Brachythecium erythrorrhizon*, Rhyt robu = *Rhytidiopsis robusta*, Trit exec = *Tritomaria exectiformis*, Pter fili = *Pterigynandrum filiforme*, Bryu arge = *Bryum argenteum*.

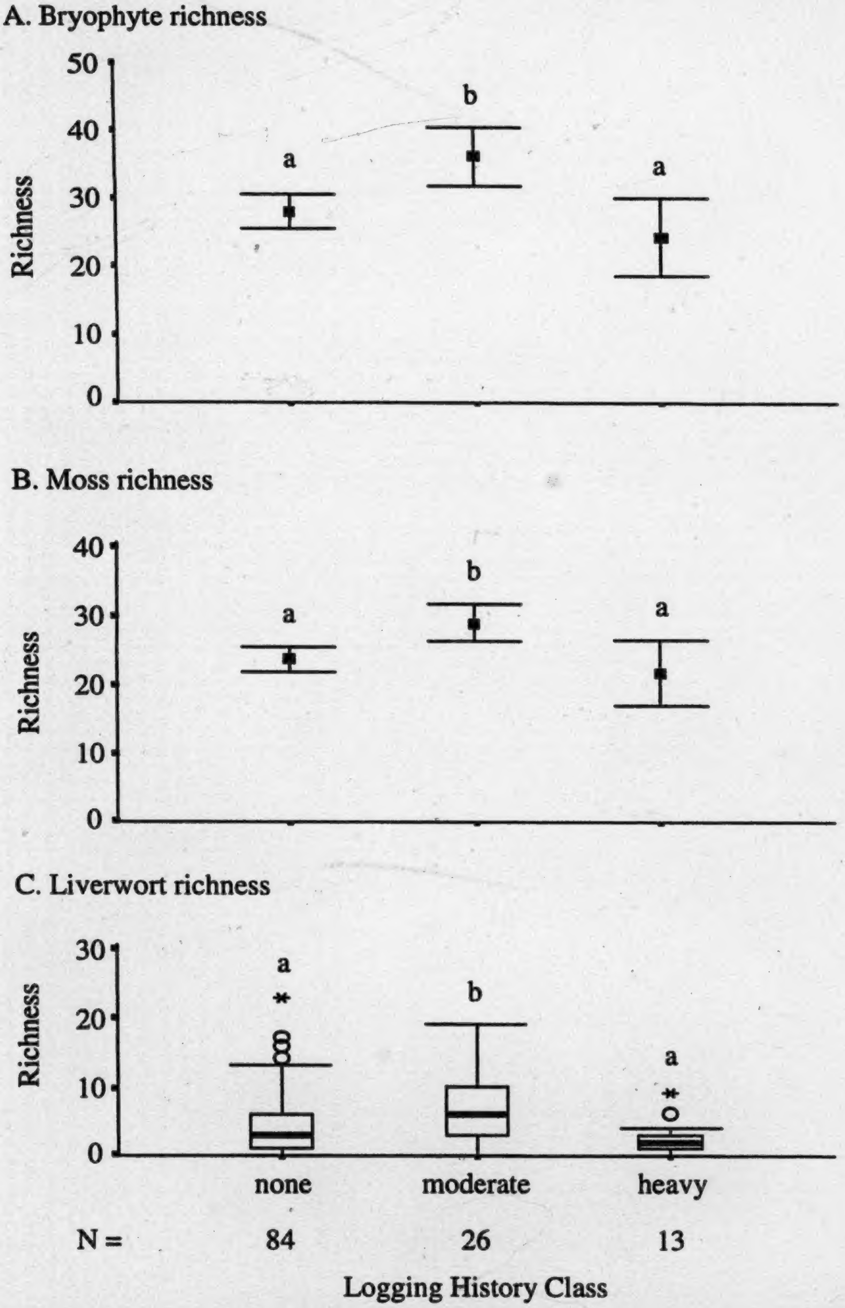
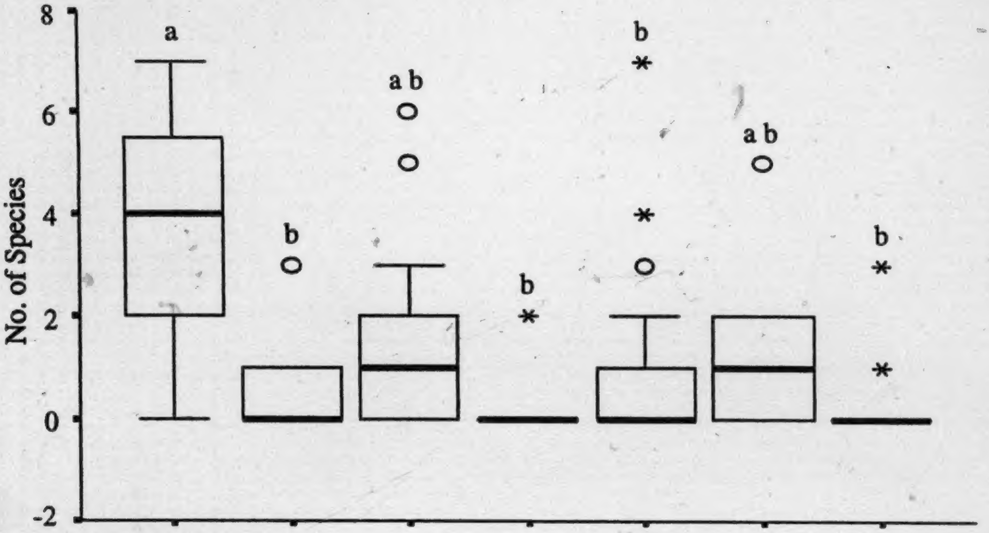


Figure 3-8A-C. Comparison of species richness for three logging history classes for the following three species groups: A. Total bryophyte richness (mean +/- 2 SE), B. Moss richness (mean +/- 2 SE) and C. Liverwort richness (box-whisker plot: see description on Figure 3-5). Logging history classes follow definitions in Table 3-2.

A. Number of rare bryophytes



B. Number of rare mosses

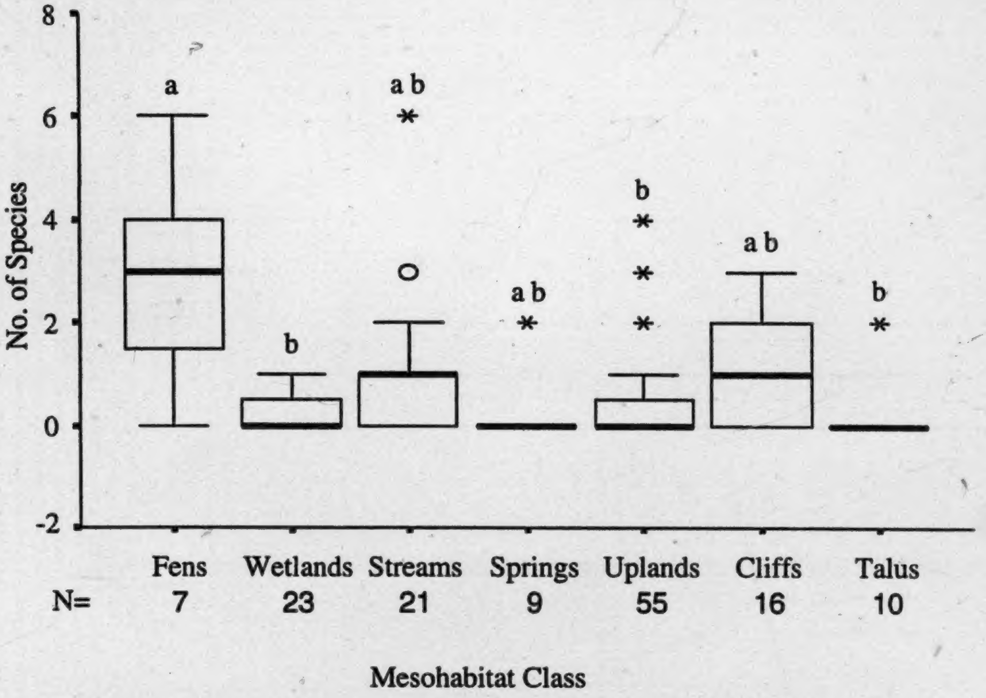


Figure 3-9A-B. Box and whisker plots (see description on Figure 3-5) of the number of rare species for seven mesohabitat classes for the following two species groups: A. number of rare bryophytes and B. number of rare mosses.

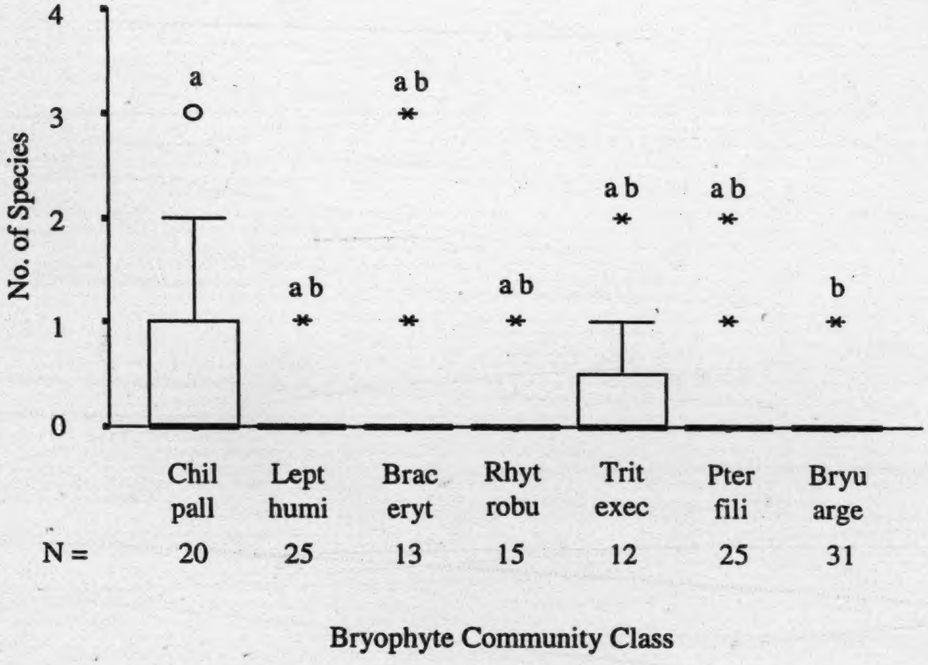


Figure 3-10. Box and whisker plot (see description on Figure 3-5) of the number of rare liverwort species for seven bryophyte community classes. Chil pall = *Chiloscyphus pallescens*, Lept humi = *Leptodictyum humile*, Brac eryt = *Brachythecium erythrorrhizon*, Rhyt robu = *Rhytidiopsis robusta*, Trit exec = *Tritomaria exectiformis*, Pter fili = *Pterigynandrum filiforme*, Bryu arge = *Bryum argenteum.*

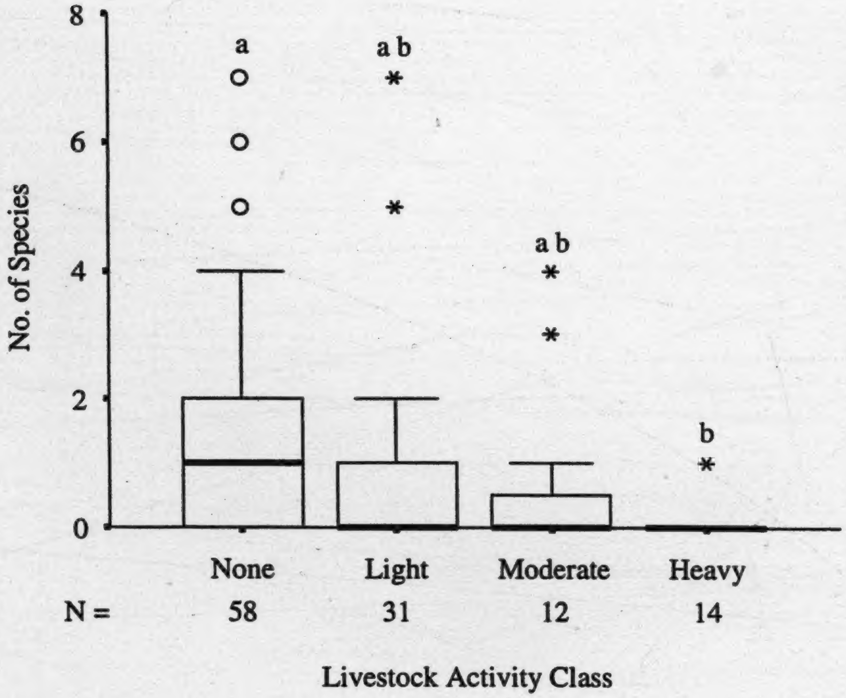


Figure 3-11. Box and whisker plot (see description on Figure 3-5) of the number of rare bryophyte species for four classes of livestock activity. Livestock activity classes follow the definitions in Table 3-2.

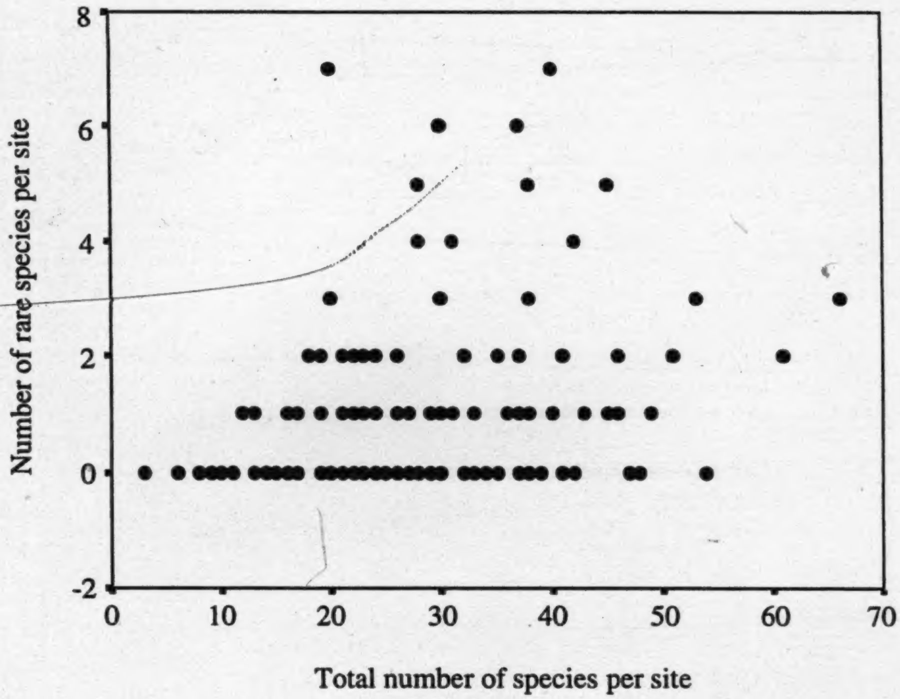


Figure 3-12. Scatterplot of the number of rare species by the number of total species in each site. Spearman rank correlation between the two variables shows a significant relationship but the correlation only explains 11.6% of the variability in the data (R=0.341, N=141, p<0.01).

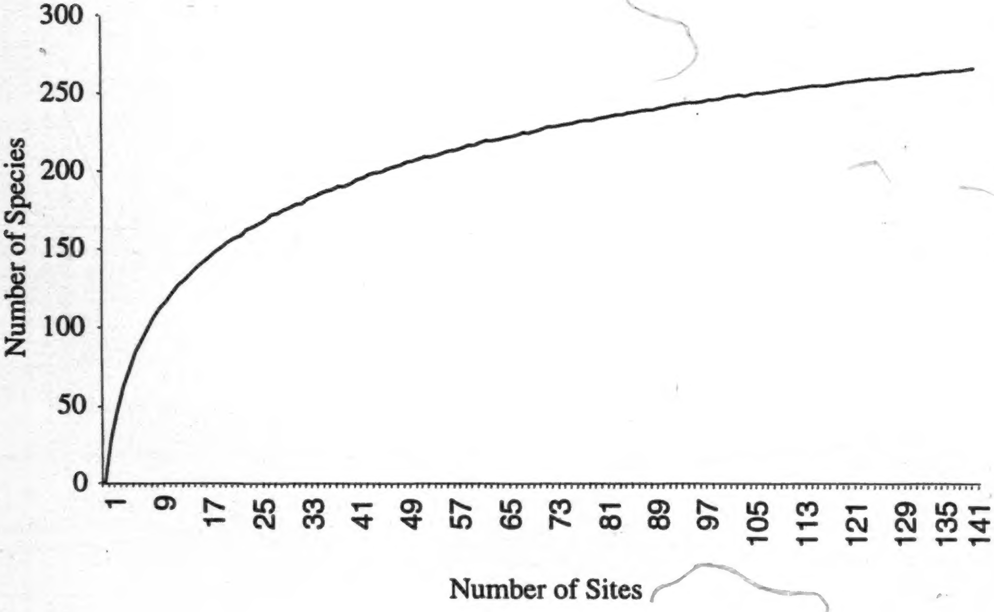


Figure 3-13. Estimated gamma diversity for all 141 sites in the study area. Estimated gamma diversities were derived from the sampling effort curve function in PC-ORD.

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Chapter 4.
Conclusion

The state of knowledge of bryophytes in Washington State.

The results of the present study underscore the lack of basic knowledge about bryophyte species and their distributions in Washington State. The study area contains a rich bryophyte flora of 266 species. Over thirteen percent of moss species had not been previously recorded in Washington according to the working list of mosses being compiled by Harpel (2002). Similar statistics could probably be worked out for the liverwort species, but no checklist currently exists.

Most of the species and distribution data for Washington State have focused in the Cascade Mountains and in the wetter, coastal forests west of the Cascade divide. The dry, interior regions of the state have previously received little to no attention bryologically (Christy & Harpel 1995, 1997; Harpel 2001). Nonetheless, the situation is set to improve.

With the implementation of the bryophyte management guidelines of the Northwest Forest Plan (United States Department of Agriculture & United States Department of the Interior 1994) on the west side of the state, distributions of species thought previously to be rare have been dramatically expanded. This supports Slack's (1992) contention that rarity for some bryophytes reflects the effort devoted to looking for them. Unfortunately, it takes government mandates to manage for organisms before action will be taken. But fortunately the process for adding bryophyte species to management lists for the entire state has begun. As this happens, awareness of bryophytes will increase, as will species reports and distributional information for all regions of Washington.

Patterns of bryophyte diversity and rarity in the study area.

The analyses of this study demonstrate that bryophyte richness and rarity do not occur ubiquitously on the landscape. They, in fact, occur more in some habitats than in others.

Bryophyte richness increases with increasing moisture, elevation and habitat complexity in the study area. Bryophyte richness differentially partitioned on the landscape according to different environmental descriptors, namely mesohabitats, biophysical environments and bryophyte communities. Mesohabitats emerge as a particularly good descriptor because they differentiate richness patterns well and are easily identified units on the landscape.

Bryophyte rarity does not reflect particular environmental gradients in the study area. Other analyses, however, did detect patterns in rarity. Rare mosses showed patterns with respect to their taxonomic and morphological characteristics as well as their geographic affinities. Rare bryophytes showed patterns in their distribution between classes of environmental descriptors, again the mesohabitats, biophysical environments and bryophyte communities. Mesohabitats, especially the unrestricted mesohabitats, emerge as important landscape components for rare bryophytes. In addition, unique sites at any scale (e.i. microhabitat, mesohabitat, habitat type) provide habitat for mosses (and likely liverworts) that wouldn't otherwise be in the area.

These patterns in richness and rarity can be used to guide conservation strategies for bryophytes in the study area.

A coarse filter approach to management.

A coarse filter partitions the landscape based on ecological, biological, or operational similarities (Haufler et al. 1996). These partitions can then be used for differential management practices based on the needs of each partition. Söderström et al. (1992) encouraged this approach to management, especially for relatively unknown bryophyte species.

Mesohabitats emerge as a good candidate for such a coarse filter approach. The classes of mesohabitat show differential patterns of richness and rarity in bryophytes. Mesohabitats are also easily defined landscape features that do not require previous knowledge of the site or need specialized bryophyte identification skills. Managers, by protecting certain mesohabitats, could protect areas of high diversity and high rarity without much effort.

The coarse filter approach does not preclude the need for more detailed studies on bryophytes in the area. Haufler et al. (1996) recognized the need for species assessments to ensure that the coarse filter provides for the needs of all species.

Managers need to implement a monitoring feedback loop in conjunction with a coarse filter approach to bryophyte conservation.

The traditional U. S. Forest Service approach to conservation focuses on micromanaging for particular species. Currently, botanists search likely habitats for species on management lists and protect the plants where they occur. It is likely that botanists will take the same approach to bryophytes when they appear on the lists. The present study can still provide guidance to this management style. The ecological data associated with particular species will help guide search efforts for listed species in the area. As well, mesohabitat patterns can still guide intuitive surveys for listed species because rare species will more likely occur in restricted mesohabitats. Finally, as managers designate stands logging or other anthropogenic disturbance, they may remember to buffer areas like fens and streams that have high potential of bryophyte conservation value.

Disturbance threats to bryophyte diversity.

The question arises as to whether bryophytes are indeed threatened in the study area. Disturbances are on going in the study area. The lower elevations experience pressure from developments, including increasing housing needs, agricultural practices and creation/maintenance of pastureland. McIntosh (1986) attributed the elimination of all but a few bryophytes on soil crusts to livestock trampling and Schofield (1994) warned of the vulnerability of bryophytes in the semi-arid regions of British Columbia due to the reduction of habitat due to this type of development.

Wildfires naturally occur throughout the study area. The use of prescribed fire as a management tool is also increasing. Many studies have shown that bryophytes proceed through successional stages after a fire to reach a stabilized state (e.g. de las Heras et al. 1994; Gorshkov & Bakkal 1996). But do the same pre-fire species occur in the recovered post-fire area? A wildfire ran through 9,400 acres of dry sagebrush and open pine forest in my study area after I had sampled for the present study. One year post-fire I found that overall species richness in the eight affected sites dropped 44.2%, from 77 to 34 species. In addition, only seven of the sixteen locally rare species survived the fire. Will these rare species return to the area? The dispersal limitation of bryophytes (Söderström 1987) may limit their ability to recolonize the area. Loss of diversity on the landscape from other disturbances may reduce the pool of species that can adequately disperse into a disturbed region, thus perpetuating the loss of species.

Logging practices also occur throughout the study area. Many studies have addressed the reduction of bryophyte species due to logging practices (Andersson & Hytteborn 1991; Brumelis & Carleton 1989; Jalonen & Vanha-Majamaa 2001; McCune 1993; Newmaster 2000; Newmaster & Bell 2002) with particular concern about the reduction in structural diversity and loss of large diameter coarse woody debris particularly important for liverwort species (Lesica et al. 1991; Rambo & Muir 1998; Söderström 1988a, 1988b). Logging practices in the area may threaten the viability of particular bryophyte species.

With the on going disturbances of development, agriculture and livestock practices, wild and prescribed fire and logging practices, concerns for bryophyte conservation seem warranted. Preservation of bryophyte species in the area will take increased awareness and active protection of species and habitats.

Future research

The present study has effectively detected patterns of richness and rarity for bryophytes in the study area however, further studies are needed to determine whether these patterns hold true for other areas. Any future research in the dry regions of eastern Washington would add valuable information on bryophyte species occurrences and their distributions in the state.

The present study did not detect differences in bryophyte richness or rarity in different disturbance histories within the study area, likely due to the high variability in the data. The focus of the study became to capture all of the bryophyte species present in the study area. Consequently, I did not capture enough replication in the disturbance histories to adequately analyze them. A study designed to deal with the complexities of analyzing disturbance histories would likely produce valuable information for managers in the area.

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Appendix A. List of 72 potential microhabitats available at each site.

- Microhabitat
- Rock crevices less that 5 cm wide
- Rock crevices between 5 cm and 1 m wide
- Rock crevices more than 1 m wide
- Horizontal rock crevices
- Vertical rock crevices
- Rock ledges (present in cliffs)
- Smooth rock
- Wet rock
- Dry rock
- Boulders
- Peat
- Shrub layer
- Deciduous trees (live, standing)
- Coniferous trees (live, standing)
- Mineral soil
- Organic soil
- Disturbed soil
- Wet hollows
- Intermittent seep
- Continuous seep
- Burnt wood
- Anthropogenic features
- 25 Log microhabitats: based on 5 size classes and 5 decay classes of wood.
- 25 Stump microhabitats: based on 5 size classes and 5 decay classes of stumps.

Log and Stump Size Classes:
1 = 0-5 cm diameter
2 = 6-15 cm diameter
3 = 16-30 cm diameter
4 = 31-45 cm diameter
5 = 45+ cm diameter.

Log and Stump Decay Classes (Hunter 1990):
1 = freshly dead, fine twigs still abundant
2 = most bark present; main branches present but small twigs not abundant; wood is hard
3 = most bark is gone, main branches are gone; the wood is still hard
4 = wood is relatively soft, most bark usually absent but in exceptions can be present
5 = wood is very soft; 1/3 to 1/2 of the log can be buried underground

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Appendix B. Species data for 141 sites sampled in the study area in the summer of 2000. Species with asterisks differ from the Anderson et al. (1990) checklist.

code	species name	author	var	var author	ssp
aloi bifr	Aloina bifrons	(De Not.) Delg.			
aloi rigi	Aloina rigida	(Hedw.) Limpr.			
ambl serp	Amblestegium serpens	(Hedw.) Schimp.			
amph lapp	Amphidium lapponicum	(Hedw.) Schimp.			
anac menz	Anacolia menziesii	(Turn.) Par.	menziesii		
andr rupe	Andreaea rupestris	Hedw.	rupestris		
atri selw	Atrichum selwynii	Aust.			
aula andr	Aulacomnium androgynum	(Hedw.) Schwaegr.			
aula palu	Aulacomnium palustre	(Hedw.) Schwaegr.			
barb conv	Barbula convoluta	Hedw.			
bart ithy	Bartramia ithyphylla	Brid.			
brac albi	Brachythecium albicans	(Hedw.) Schimp.			
brac bola	Brachythecium bolanderi	(Lesq.) Jaeg.			
brac coll	Brachythecium collinum	(C. Mull.) Schimp.			
brac eryt	Brachythecium erythrorrhizon	Schimp.			
brac frig	Brachythecium frigidum	(C. Mull.) Besch.			
brac holz	Brachythecium holzingeri	(Grout) Grout			
brac hylo	Brachythecium hylotapetum	B. Hig. & N. Hig.			
brac leib	Brachythecium leibergii	Grout			
brac nels	Brachythecium nelsonii	Grout			
brac oedi	Brachythecium oedipodium	(Mitt.) Jaeg.			
brac oxyc	Brachythecium oxycladon	(Brid.) Jaeg.			
brac rivu	Brachythecium rivulare	Schimp.			
brac sale	Brachythecium salebrosum	(Web. & Mohr) Schimp.	salebrosum		
brac velu	Brachythecium velutinum	(Hedw.) Schimp.			
bryo recu	Bryoerythrophyllum recurvirostre	(Hedw.) Chen			
bryu arge	Bryum argenteum	Hedw.			
bryu caes	Bryum caespiticium	Hedw.			
bryu calo	Bryum calobryoides	Spence			
bryu capi	Bryum capillare	Hedw.	capillare		
bryu gemm	Bryum gemmiparum	De Not.			
bryu lisa cusp	Bryum lisae	De Not.	cuspidatum	(Bruch & Schimp.) Marg.	
bryu mini	Bryum miniatum	Lesq.			
bryu mueh	Bryum muehlenbeckii	Bruch & Schimp.			
bryu pall	Bryum pallescens	Schwaegr.			
bryu pseu	Bryum pseudotriquetrum	(Hedw.) Gaertn. et al.			
bryu suba	Bryum subapiculatum	Hampe			
bryu turb	Bryum turbinatum	(Hedw.) Turn.			
bryu weig	Bryum weigelii	Spreng.			
buxb aphy	Buxbaumia aphylla	Hedw.			
buxb pipe	Buxbaumia piperi	Best			
buxb viri	Buxbaumia viridis	(DC.) Moug. & Nestl.			
call giga	Calliergon giganteum	(Schimp.) Kindb.			
call rich	Calliergon richardsonii	(Mitt.) Kindb.			
call stra	Calliergon stramineum	(Brid.) Kindb.			
camp poly	Campylium polygamum	(Schimp. in B.S.G.) C. Jens			
cera purp	Ceratodon purpureus	(Hedw.) Brid.	purpureus		
clao bola	Claopodium bolanderi	Best			
cona comp	Conardia compacta	(C. Mull.) Robins.			
cosc caly	Coscinodon calyptratus	(Hook.) Kindb.			
crat fili	Cratoneuron filicinum	(Hedw.) Spruce			
cyno stru	Cynodontium strumiferum	(Hedw.) Lindb.			
desm cern	Desmatadon cernuus	(Hub.) Bruch & Schimp.			
desm conv	Desmatadon convolutus	(Brid.) Grout			
desm heim	Desmatadon heimii	(Hedw.) Mitt.	heimii		
desm lati	Desmatadon latifolius	(Hedw.) Brid.			
dich pell	Dichodontium pellucidum	(Hedw.) Schimp.			
dich unci	Dichelyma uncinatum	Mitt.			
dicr crispa	Dicranella crispa	(Hedw.) Schimp.			
dicr crispu	Dicranoweisia crispula	(Hedw.) Milde			
dicr elon	Dicranum elongatum	Schwaegr.			
dicr fusc	Dicranum fuscescens	Turn.	fuscescens		
dicr mont	Dicranum montanum	Hedw.			
dicr palu	Dicranella palustris	(Dicks.) Warb.			
dicr poly	Dicranum polysetum	Sw.			
dicr schr robu	Dicranella schreberiana	(Hedw.) Crum & Anderson	robusta	(Braithw.) Crum & Anderson	
dicr scop	Dicranum scoparium	Hedw.			
dicr taur	Dicranum tauricum	Sapeh.			
didy brac	*Didymodon brachyphyllus	(Sull.) Zand.			
didy rigi	Didymodon rigidulus	Hedw.			
didy toph	Didymodon tophaceus	(Brid.) Lisa			
didy vine	Didymodon vinealis	(Brid.) Zand.	vinealis		
dist capi	Distichium capillaceum	(Hedw.) Bruch & Schimp.	capillaceum		

code	ssp author	10a	10b	10g	10j	11a	11b	11c	11h	12a	12f	12j	13a	13b	13g	13j	14d	15a	15c	16a
aloi bifr		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aloi rigi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ambl serp		0	1	0	1	0	1	1	1	0	0	1	0	1	0	1	1	0	1	0
amph lapp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
anac menz		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
andr rupe		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atri selw		0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
aula andr		0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
aula palu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
barb conv		1	1	1	1	1	1	0	1	1	0	1	1	1	0	1	1	0	0	1
bart ithy		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac albi		1	1	0	1	1	0	0	1	0	0	1	0	1	0	1	1	1	0	1
brac bola		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac coll		1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
brac eryt		0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac frig		0	0	0	0	0	1	1	1	0	0	0	0	1	0	1	1	0	1	1
brac holz		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac hylo		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac leib		1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
brac nels		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac oedi		0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
brac oxyc		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
brac rivu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac sale		1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0
brac velu		1	1	1	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1
bryo recu		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
bryu arge		0	0	0	0	1	1	0	0	1	1	1	1	0	0	0	0	0	0	0
bryu caes		1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1
bryu calo		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu capi		0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
bryu gemm		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu lisa cusp		1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
bryu mini		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu mueh		0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
bryu pall		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu pseu		0	1	0	0	0	1	1	1	0	0	1	0	0	0	1	1	0	1	0
bryu suba		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu turb		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu weig		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
buxb aphy		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb pipe		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb viri		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call giga		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call rich		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call stra		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
camp poly		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cera purp		1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0
clao bola		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cona comp		0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0
cosc caly		0	0	0	0	1	1	0	0	1	1	1	0	1	1	1	0	0	0	0
crat fili		0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	1	0	1	0
cyno stru		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm cern		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm conv		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm heim		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
desm lati		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich pell		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich unci		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr crispa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr crispu		1	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0
dicr elon		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr fusc		1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
dicr mont		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr palu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr poly		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr schr robu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
dicr scop		1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
dicr taur		1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
didy brac		0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0
didy rigi		0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
didy toph		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
didy vine		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
dist capi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

code	16f	16g	17a	17b	17d	17h	18a	18b	19a	19f	19g	19h	1a	1b	1f	1g	20b	21a	21e	21f	22a
aloi bifr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aloi rigi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ambl serp	0	0	0	1	1	1	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0
amph lapp	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
anac menz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
andr rupe	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atri selw	1	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	1	1
aula andr	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0
aula palu	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
barb conv	1	0	1	1	0	1	1	0	1	0	0	0	0	1	0	0	1	0	1	1	1
bart ithy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac albi	1	0	1	1	0	1	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0
brac bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac coll	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
brac eryt	0	0	0	1	1	1	0	1	0	0	0	0	0	1	0	0	1	1	1	0	0
brac frig	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	0	0
brac holz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac hylo	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
brac leib	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0
brac nels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac oedi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
brac oxyc	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0
brac rivu	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0
brac sale	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0
brac velu	0	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0
bryo recu	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
bryu arge	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
bryu caes	0	0	1	1	1	1	1	0	1	1	0	1	1	1	1	0	0	1	1	1	1
bryu calo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu capi	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0
bryu gemm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu lisa cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu mini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu mueh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu pall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu pseu	0	0	0	1	1	1	1	1	0	1	0	0	0	1	0	0	1	1	1	0	0
bryu suba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu turb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu weig	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
buxb aphy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb pipe	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb viri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call giga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call rich	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
call stra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
camp poly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cera purp	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1
clao bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cona comp	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
cosc caly	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0
crat fili	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
cyno stru	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm cern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm conv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm heim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm lati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich pell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
dich unci	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr crispa	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr crispu	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr elon	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr fusc	0	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0
dicr mont	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr palu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
dicr poly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr schr robu	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
dicr scop	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0
dicr taur	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1
didy brac	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
didy rigi	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
didy toph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
didy vine	1	0	0	0	0	0	0	0	1	1	0	1	1	1	1	0	1	0	0	1	0
dist capi	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

code	22f	23a	24a	24b	24c	24f	25a	26a	27b	28a	28c	28e	28f	29a	29b	29f	29g	2a	2j	30a	31a
aloi bifr	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
aloi rigi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ambl serp	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
amph lapp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
anac menz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
andr rupe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
atri selw	0	1	1	1	0	0	0	0	0	1	0	0	0	1	1	1	1	0	0	0	1
aula andr	0	1	0	1	1	1	0	0	1	1	1	0	1	0	1	0	0	0	0	0	0
aula palu	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
barb conv	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
bart ithy	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0
brac albi	0	1	1	0	1	1	0	0	0	1	1	0	1	1	1	0	1	0	0	0	1
brac bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac coll	1	1	1	1	1	1	1	1	0	1	0	0	0	0	1	1	1	0	0	1	0
brac eryt	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
brac frig	0	0	0	0	1	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0
brac holz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac hylo	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1
brac leib	0	1	1	0	0	1	0	1	1	1	0	0	0	0	1	0	0	0	0	1	1
brac nels	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
brac oedi	0	0	1	0	0	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0	1
brac oxyc	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0
brac rivu	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
brac sale	0	1	1	1	1	0	0	0	1	1	1	0	0	0	1	0	1	0	0	0	1
brac velu	0	1	1	1	0	1	1	0	0	1	1	0	0	0	1	0	1	0	1	1	1
bryo recu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu arge	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
bryu caes	1	1	1	1	1	0	0	0	1	1	1	0	1	0	0	0	1	1	1	1	1
bryu calo	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu capi	1	0	1	0	0	1	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0
bryu gemm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu lisa cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu mini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu mueh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu pall	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu pseu	1	0	0	1	1	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1
bryu suba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
bryu turb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu weig	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb aphy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
buxb pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb viri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
call giga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call rich	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call stra	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
camp poly	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
cera purp	1	1	1	1	1	1	1	0	0	1	1	0	1	1	1	0	1	1	1	1	1
clao bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
cona comp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
cosc caly	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
crat fili	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
cyno stru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
desm cern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm conv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
desm heim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm lati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
dich pell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich unci	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr crispa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr crispu	1	0	1	1	0	0	0	0	0	1	1	0	0	0	1	1	1	0	0	1	0
dicr elon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr fusc	0	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	1
dicr mont	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
dicr palu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr poly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr schr robu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr scop	0	1	1	0	1	0	0	0	0	1	0	0	0	1	1	1	1	0	0	0	0
dicr taur	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1
didy brac	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
didy rigi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
didy toph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
didy vine	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0
dist capi	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0

code	31b	32a	33c	33d	34a	34c	34d	35f	35g	35j	36d	36e	37a	37j	38a	38c	39a	3a	3b	40h	41a
aloi bifr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aloi rigi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ambl serp	1	0	0	0	0	1	1	0	0	1	1	1	0	1	0	1	0	0	1	1	0
amph lapp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
anac menz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
andr rupe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atri selw	1	1	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1
aula andr	1	1	1	0	0	1	0	0	0	1	0	1	1	1	0	1	0	0	1	1	1
aula palu	1	0	1	1	0	1	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0
barb conv	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0
bart ithy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac albi	1	1	0	0	1	0	0	0	0	0	1	1	1	0	1	1	1	0	1	1	0
brac bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac coli	1	1	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0
brac eryt	1	0	1	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0
brac frig	0	0	1	0	0	1	1	0	0	1	1	1	0	1	1	1	0	0	1	0	0
brac holz	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
brac hylo	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
brac leib	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
brac nels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac oedi	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
brac oxyc	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	0	1	0
brac rivu	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
brac sale	0	0	1	0	1	0	1	0	0	1	1	1	1	1	0	0	0	0	1	1	1
brac velu	0	0	1	0	0	0	0	1	1	1	0	1	1	1	0	0	0	0	1	1	1
bryo recu	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
bryu arge	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
bryu caes	0	1	1	1	1	0	1	1	0	0	0	1	0	1	1	1	1	1	1	1	0
bryu calo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu capi	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0
bryu gemm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu lisa cusp	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
bryu mini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu mush	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu pall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu pseu	1	0	1	1	0	1	1	1	0	1	1	1	0	1	0	1	0	0	1	1	0
bryu suba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu turb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu weig	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb aphy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb viri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call giga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call rich	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call stra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
camp poly	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
cera purp	0	1	1	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1
clao bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cona comp	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
cosc caly	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
crat fili	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0
cyno stru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm cern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm conv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm heim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm lati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich pell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich unci	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr crispa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr crispu	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0
dicr elon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr fusc	1	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0	0	0	1
dicr mont	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr palu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr poly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr schr robu	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
dicr scop	0	0	1	0	1	1	0	0	1	0	0	1	1	1	1	0	0	0	0	1	1
dicr taur	0	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1
didy brac	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
didy rigi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
didy toph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
didy vine	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
dist capi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

code	42a	42c	43a	43c	44a	45a	45b	46a	47a	47b	47e	48a	48g	49b	4a	4c	4f	50a	50d	51a	52a
aloi bifr	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aloi rigi	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ambl serp	1	0	1	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0
amph lapp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
anac menz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
andr rupe	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
atri selw	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1
aula andr	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	1
aula palu	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	1
barb conv	1	1	1	0	1	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	1
bart ithy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
brac albi	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0
brac bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac coli	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac eryt	1	0	0	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	1
brac frig	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0
brac holz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac hylo	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1
brac leib	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	1	0	1	0
brac nels	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0
brac oedi	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	1
brac oxyc	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0
brac rivu	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
brac sale	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	1	0	1	1	0	0
brac velu	0	0	0	0	0	0	0	1	1	0	1	1	1	1	0	1	0	1	0	1	0
bryo recu	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu arge	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu caes	1	0	1	0	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0	0	1
bryu calo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu capi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
bryu gemm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu lisa cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu mini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu mueh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
bryu pall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu pseu	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	0	1	1	0	0
bryu suba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu turb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
bryu weig	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
buxb aphy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb viri	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
call giga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call rich	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call stra	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
camp poly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cera purp	1	0	1	0	1	1	1	1	0	1	1	1	0	0	1	1	1	1	0	1	1
clao bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cona comp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
cosc caly	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
crat fili	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0
cyno stru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm cern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
desm conv	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm heim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm lati	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich pell	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich unci	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
dicr crispa	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
dicr crispu	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0
dicr elon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr fusc	0	0	0	0	0	0	0	1	1	1	0	1	1	1	0	1	0	1	1	1	1
dicr mont	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr palu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr poly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr schr robu	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr scop	0	0	0	0	0	0	0	1	1	0	0	1	1	1	0	1	0	0	0	0	0
dicr taur	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0	1	0	1	1	1	0
didy brac	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
didy rigi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
didy toph	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
didy vine	1	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0
dist capi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

code	53e	54a	54b	55a	56e	57j	58b	59a	5a	5c	5h	60a	60c	60h	61c	61f	62d	63b	64b	65f	65h
aloi bifr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aloi rigi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ambl serp	1	0	0	0	1	1	0	0	0	1	0	0	1	1	1	0	1	0	1	1	1
amph lapp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
anac menz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
andr rupe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atri selw	0	1	1	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
aula andr	1	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	0	0
aula palu	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
barb conv	0	0	0	0	0	1	0	1	0	1	1	1	1	1	1	0	0	0	0	0	1
bart ithy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac albi	0	1	1	1	0	1	0	1	0	1	1	1	0	0	1	0	0	0	0	0	1
brac bola	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac coll	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac eryt	1	1	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0
brac frig	1	0	1	0	1	0	1	0	0	1	0	0	0	1	1	0	1	1	1	1	1
brac holz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac hylo	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
brac leib	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
brac nels	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
brac oedi	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
brac oxyc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac rivu	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
brac sale	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	0	1	1	1	0	1
brac velu	0	1	1	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	1
bryo recu	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
bryu arge	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	1
bryu caes	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	0	0	1	0	0	1
bryu calo	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu capi	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
bryu gemm	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu lisa cusp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu mini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu mueh	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu pall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
bryu pseu	1	1	1	0	1	0	1	0	0	1	0	0	1	0	1	0	1	1	1	0	1
bryu suba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu turb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu weig	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb aphy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb pipe	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb viri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call giga	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call rich	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call stra	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
camp poly	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cera purp	1	0	0	1	1	1	0	1	1	1	1	1	0	0	1	0	0	0	0	1	1
clao bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cona comp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0
cosc caly	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
crat fili	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0
cyno stru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm cern	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
desm conv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm heim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
desm lati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich pell	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich unci	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr crispa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
dicr crispu	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0
dicr elon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr fusc	0	1	1	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1
dicr mont	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr palu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr poly	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr schr robu	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr scop	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1
dicr taur	0	1	1	0	1	1	1	0	0	0	0	0	1	1	1	0	1	1	1	0	1
didy brac	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
didy rigi	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
didy toph	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
didy vine	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0
dist capi	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0

code	66j	67d	68e	6a	6f	6g	6j	7a	7b	7d	8a	8b	8f	9a	9c	9f	9g
aloi bifr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aloi rigi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ambl serp	0	1	0	0	0	0	1	0	1	1	0	1	1	1	1	0	0
amph lapp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
anac menz	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
andr rupe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atri selw	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
aula andr	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
aula palu	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
barb conv	0	0	0	1	1	1	1	1	0	0	0	0	0	1	1	0	1
bart ithy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac albi	1	1	0	1	0	0	1	0	0	0	0	1	0	1	1	1	1
brac bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac coll	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
brac eryt	1	1	1	1	0	0	1	0	1	1	0	1	0	0	0	0	0
brac frig	0	1	0	1	0	0	0	0	0	1	0	1	0	0	1	0	0
brac holz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac hylo	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0
brac leib	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1
brac nels	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac oedi	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
brac oxyc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brac rivu	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
brac sale	0	1	0	0	0	0	0	1	1	1	1	0	0	1	1	0	0
brac velu	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	1
bryo recu	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
bryu arge	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
bryu caes	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	0	1
bryu calo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu capi	0	0	0	0	1	0	1	0	0	0	1	1	0	1	1	0	0
bryu gemm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu lisa cusp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
bryu mini	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
bryu mueh	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0
bryu pall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu pseu	1	1	0	0	1	0	1	0	1	1	0	0	1	1	1	0	0
bryu suba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu turb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bryu weig	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
buxb aphy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
buxb viri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call giga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call rich	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
call stra	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
camp poly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cera purp	1	0	0	1	1	1	1	1	1	0	1	0	0	1	1	0	1
clao bola	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
cona comp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
cosc caly	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0
crat fili	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cyno stru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm cern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm conv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
desm heim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
desm lati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich pell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dich unci	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr crispa	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
dicr crispu	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
dicr elon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr fusc	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
dicr mont	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr palu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr poly	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
dicr schr robu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dicr scop	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
dicr taur	0	1	0	1	0	1	0	1	1	1	0	0	0	1	1	0	1
didy brac	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
didy rigi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
didy toph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
didy vine	0	0	0	0	1	0	0	0	0	0	0	1	1	0	1	1	0
dist capi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

code	species name	author	var	var author	ssp
ditr flex	Ditrichum flexicaule	(Schwaegr.) Hampe			
drep adun	Drepanocladus aduncus	(Hedw.) Warnst.			
drep capi	Drepanocladus capillifolius	(Warnst.) Warnst.			
drep send	Drepanocladus sendtneri	(Schimp.) Warnst.			
dryp pate	Dryptodon patens	(Hedw.) Brid.			
enca cili	Encalypta ciliata	Hedw.			
enca proc	Encalypta procera	Bruch			
enca rhap	Encalypta rhaptocarpa	Schwaegr.			
enca vulg	Encalypta vulgaris	Hedw.			
eurh pulc pulc	Eurhynchium pulchellum	(Hedw.) Jenn.	pulchellum		
fiss bryo	Fissidens bryoides	Hedw.			
font anti anti	Fontinalis antipyretica	Hedw.	antipyretica		
font hypn hypn	Fontinalis hypnoides	Hartm.	hypnoides		
funa hygr	Funaria hygrometrica	Hedw.			
grim alpe	*Grimmia alpestris	(Weber & Mohr) Schleich.			
grim anod	Grimmia anodon	Bruch & Schimp.			
grim laev	Grimmia laevigata	(Brid.) Brid.			
grim long	*Grimmia longirostris	Hook.			
grim mont	Grimmia montana	Bruch & Schimp.			
grim oval	Grimmia ovalis	(Hedw.) Lindb.			
grim pulv	Grimmia pulvinata	(Hedw.) Sm.	pulvinata		
grim refl	*Grimmia reflexidens	Mull. Hal.			
grim torq torq	Grimmia torquata	Hornsch.	torquata		
gymn aeru	Gymnostomum aeruginosum	Sm.			
hama vern	Hamatocaulis vernicosus	(Mitt.) Hedenas			
helo blan	Helodium blandowii	(Web. & Mohr) Warnst.	blandowii		
herz seli	Herzogiella seligeri	(Brid.) Iwats.			
homa neva	Homalothecium nevadense	(Lesq.) Ren. & Card.			
hygr best	Hygrohypnum bestii	(Ren. & Bryhn) Broth.			
hygr luri	Hygrohypnum luridum	(Hedw.) Jenn.			
hygr moll	Hygrohypnum molle	(Hedw.) Loeske			
hygr ochr	Hygrohypnum ochraceum	(Wils.) Loeske			
hygr tena	Hygroamblystegium tenax	(Hedw.) Jenn.			
hylo sple	Hylocomium splendens	(Hedw.) Schimp.			
hypn circ	Hypnum circinale	Hook.			
hypn lind	Hypnum lindbergii	Mitt.			
hypn prat	Hypnum pratense	(Rabenh.) Spruce			
hypn revo	Hypnum revolutum	(Mitt.) Lindb.			
isop pulc	Isopterygiopsis pulchella	(Hedw.) Iwats.			
lept humi	Leptodictyum humile	(P. Beauv.) Ochyra			
lept pyri	Leptobryum pyriforme	(Hedw.) Wils.			
lept ripa	Leptodictyum riparium	(Hedw.) Warnst.			
lesc incu incu	*Lescuraea incurvata	(Hedw.) Lawt.	incurvata		
lesc pate	*Lescuraea patens	(Lindb) Arn. & C. Jens.			
lesc radi radi	*Lescuraea radicosa	(Mitt.) Moenk.	radicosa		
lesc sten	*Lescuraea stenophylla	(Ren. & Card.) Kindb.			
limp revo	Limprichtia revolvens	(Sw.) Loeske			
mees long	Meesia longiseta	Hedw.			
mees triq	Meesia triquetra	(Richt.) Angstr.			
meta menz	Metaneckera menziesii	(Hook.) Steere			
mniu ambi	Mnium ambiguum	H. Mull.			
mniu marg	Mnium marginatum	(With.) P. Beauv.			
mniu spin	Mnium spinulosum	Bruch & Schimp.			
neck doug	Neckera douglasii	Hook.			
orth affi	Orthotrichum affine	Brid.			
orth alpe	Orthotrichum alpestre	Hornsch.			
orth anom	Orthotrichum anomalum	Hedw.			
orth cupu	Orthotrichum cupulatum	Brid.			
orth hall	Orthotrichum hallii	Sull. & Lesq.			
orth holz	Orthotrichum holzingeri	Ren. & Card.			
orth laev	Orthotrichum laevigatum	Zett.			
orth obtu	Orthotrichum obtusifolium	Brid.			
orth pell	Orthotrichum pellucidum	Lindb.			
orth pumi	Orthotrichum pumilum	Sw.			
orth rupe	Orthotrichum rupestre	Schwaegr.			
orth spec spec	Orthotrichum speciosum	Nees	speciosum		
palu squa	Paludella squarrosa	(Hedw.) Brid.			
phas cusp	Phascum cuspidatum	Hedw.			
phil font	Philonotis fontana	(Hedw.) Brid.			
phys sp	Physcomitrium sp.				
phys wash	Physcomitrium washingtoniense	Crum & Anderson			
plag cusp	Plagiomnium cuspidatum	(Hedw.) T. Kop.			
plag dent	Plagiothecium denticulatum	(Hedw.) Schimp.			
plag elli	Plagiomnium ellipticum	(Brid.) T. Kop.			
plag laet	Plagiothecium laetum	Schimp.			

code	ssp author	10a	10b	10g	10j	11a	11b	11c	11h	12a	12f	12j	13a	13b	13g	13j	14d	15a	15c	16a
ditr flex		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
drep adun		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
drep capi		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
drep send		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dryp pate		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca cili		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
enca proc		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca rhap		0	0	0	0	1	0	0	1	1	0	0	1	1	0	0	0	0	0	1
enca vulg		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
eurh pulc pulc		1	0	1	0	1	0	0	1	0	0	1	0	1	0	0	0	1	1	1
fiss bryo		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
font anti anti		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
font hypn hypn		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
funa hygr		0	0	0	0	1	0	0	1	0	0	1	1	1	0	0	1	0	1	1
grim alpe		1	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	0	0	0
grim anod		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim laev		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
grim long		0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
grim mont		1	0	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0
grim oval		0	0	1	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0
grim pulv		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim refl		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim torq torq		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gymn aeru		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hama vern		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
helo blan		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
herz seli		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
homa neva		1	0	1	0	0	0	0	1	0	1	1	0	1	0	1	0	1	1	1
hygr best		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr luri		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr moll		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr ochr		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr tena		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
hylo sple		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
hypn circ		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn lind		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn prat		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn revo		0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
isop pulc		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
lept humi		0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0
lept pyri		1	1	0	1	0	0	1	1	0	0	1	0	1	0	1	1	1	1	1
lept ripa		0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0
lesc incu incu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc pate		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc radi radi		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc sten		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
limp revo		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees long		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees triq		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
meta menz		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mniu ambi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mniu marg		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mniu spin		0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1
neck doug		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth affi		0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	0
orth alpe		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth anom		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth cupu		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
orth hall		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth holz		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth laev		1	0	1	0	0	0	0	0	1	1	1	0	1	0	1	0	0	1	0
orth obtu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pell		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pumi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth rupe		0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0
orth spec spec		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
palu squa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phas cusp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phil font		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phys sp		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
phys wash		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag cusp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
plag dent		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
plag elli		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
plag laet		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

code	16f	16g	17a	17b	17d	17h	18a	18b	19a	19f	19g	19h	1a	1b	1f	1g	20b	21a	21e	21f	22a
ditr flex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
drep adun	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
drep capi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
drep send	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dryp pate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca cili	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca proc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
enca rhap	1	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0
enca vulg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
eurh pulc pulc	1	0	1	1	0	0	1	1	1	0	0	1	0	1	0	0	1	1	1	1	0
fiss bryo	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
font anti anti	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
font hypn hypn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
funa hygr	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
grim alpe	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0
grim anod	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim laev	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
grim long	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
grim mont	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
grim oval	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	1	0	0	0	0	0
grim pulv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim refl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim torq torq	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
gymn aeru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hama vern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
helo blan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
herz seli	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
homa neva	1	0	0	0	1	1	0	0	1	1	1	1	0	0	1	1	1	1	1	0	0
hygr best	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr luri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
hygr moll	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr ochr	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr tena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hylo sple	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
hypn circ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn lind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn prat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
hypn revo	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
isop pulc	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
lept humi	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
lept pyri	1	0	1	1	1	1	1	1	0	0	0	1	0	1	0	0	1	1	1	1	0
lept ripa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
lesc incu incu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc pate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc radi radi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc sten	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
limp revo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees triq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
meta menz	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mniu ambi	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
mniu marg	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	1	0	1	0	0
mniu spin	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0
neck doug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
orth affi	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
orth alpe	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0
orth anom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth cupu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth hall	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
orth holz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
orth laev	1	1	1	0	1	1	0	0	1	1	1	1	1	1	0	1	1	0	1	1	1
orth oblu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pumi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth rupe	1	0	1	0	1	0	0	0	1	1	1	1	0	0	1	0	1	0	1	1	0
orth spec spec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
palu squa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phas cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phil font	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
phys sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phys wash	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag dent	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
plag elli	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	1	0	1	0	0
plag laet	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

code	22f	23a	24a	24b	24c	24f	25a	26a	27b	28a	28c	28e	28f	29a	29b	29f	29g	2a	2j	30a	31a
ditr flex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
drep adun	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0
drep capi	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
drep send	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dryp pate	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
enca cili	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca proc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca rhap	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
enca vulg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
eurh pulc pulc	1	0	1	0	0	1	0	0	1	0	0	0	1	1	1	1	0	0	0	1	0
fiss bryo	0	0	1	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
font anti anti	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
font hypn hypn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
funa hygr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
grim alpe	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim anod	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim laev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim mont	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0
grim oval	1	0	1	0	0	1	1	0	0	0	0	0	1	0	0	0	1	1	1	0	0
grim pulv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim refl	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim torq torq	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
gymn aeru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hama vern	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
helo blan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
herz seli	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
homa neva	1	1	0	0	0	1	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0
hygr best	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
hygr luri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr moll	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr ochr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr tena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hylo sple	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
hypn circ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn lind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn prat	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
hypn revo	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
isop pulc	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lept humi	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
lept pyri	0	1	1	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	1
lept ripa	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
lesc incu incu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc pate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc radi radi	1	0	1	1	0	1	0	0	0	0	1	0	0	0	0	1	1	0	0	1	0
lesc sten	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
limp revo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees long	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
mees triq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
meta menz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
mniu ambi	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
mniu marg	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0
mniu spin	0	0	0	1	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0
neck doug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth affi	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
orth alpe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
orth anom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth cupu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth hall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth holz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth laev	1	1	0	1	1	1	0	0	0	1	1	0	1	1	0	1	0	0	0	1	0
orth obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pumi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth rupe	1	0	1	1	0	1	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0
orth spec spec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
palu squa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phas cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phil font	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
phys sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phys wash	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
plag cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag dent	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0
plag elli	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0
plag laet	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1

code	31b	32a	33c	33d	34a	34c	34d	35f	35g	35j	36d	36e	37a	37j	38a	38c	39a	3a	3b	40h	41a
ditr flex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
drep adun	0	0	1	1	0	1	1	0	0	0	1	1	0	1	0	0	0	0	1	0	0
drep capi	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
drep send	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dryp pate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca cili	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca proc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca rhap	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
enca vulg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
eurh pulc pulc	1	0	0	0	1	0	0	0	0	0	0	1	1	1	1	0	1	0	1	0	0
fiss bryo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
font anti anti	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
font hypn hypn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
funa hygr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim alpe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim anod	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim laev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim mont	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
grim oval	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
grim pulv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim refl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim torq torq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gymn aeru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hama vern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
helo blan	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
herz seli	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
homa neva	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr best	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr luri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr moll	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr ochr	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr tena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hylo sple	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn circ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn lind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn prat	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
hypn revo	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
isop pulc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lept humi	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0
lept pyri	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	1	1	1
lept ripa	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
lesc incu incu	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
lesc pate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc radi radi	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
lesc sten	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
limp revo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees triq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
meta menz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mniu ambi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mniu marg	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
mniu spin	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1
neck doug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth affi	0	0	0	0	0	1	1	0	0	1	0	0	0	1	0	1	0	0	1	0	0
orth alpe	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
orth anom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth cupu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth hall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth holz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth laev	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0
orth obtu	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pumi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth rupe	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	1	0	0
orth spec spec	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
palu squa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phas cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
phil font	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
phys sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phys wash	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag dent	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
plag elli	0	0	0	0	0	0	1	0	0	1	1	1	0	1	0	1	0	0	0	0	0
plag last	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

code	42a	42c	43a	43c	44a	45a	45b	46a	47a	47b	47e	48a	48g	49b	4a	4c	4f	50a	50d	51a	52a
ditr flex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
drep adun	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0
drep capi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
drep send	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dryp pate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
enca cili	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca proc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca rhap	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
enca vulg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
eurh pulc pulc	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0
fiss bryo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
font anti anti	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
font hypn hypn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
funa hygr	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1
grim alpe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
grim anod	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim laev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
grim mont	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
grim oval	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0
grim pulv	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim refl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim torq torq	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
gymn aeru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hama vern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
helo blan	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
herz seli	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
homa neva	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
hygr best	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr luri	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
hygr moll	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr ochr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr tena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hylo sple	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn circ	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
hypn lind	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn prat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn revo	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
isop pulc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lept humi	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lept pyri	1	1	0	0	1	0	1	1	0	0	0	0	0	1	0	1	0	1	1	0	1
lept ripa	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
lesc incu incu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
lesc pate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc radi radi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
lesc sten	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
limp revo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees triq	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
meta menz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mniu ambi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mniu marg	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
mniu spin	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
neck doug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth affi	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0
orth alpe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth anom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth cupu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth hall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
orth holz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth laev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
orth obtu	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pumi	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth rupe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth spec spec	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
palu squa	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
phas cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phil font	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
phys sp	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phys wash	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag dent	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	0
plag elli	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0
plag laet	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0

code	53e	54a	54b	55a	56e	57j	58b	59a	5a	5c	5h	60a	60c	60h	61c	61f	62d	63b	64b	65f	65h
ditr flex	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
drep adun	1	0	0	0	1	0	0	0	0	1	0	0	1	0	1	0	1	0	0	0	0
drep capi	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
drep send	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dryp pate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca cili	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca proc	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
enca rhap	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0
enca vulg	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
eurh pulc pulc	0	1	1	1	0	1	1	1	0	0	0	1	0	1	1	0	0	1	1	1	1
fiss bryo	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
font anti anti	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
font hypn hypn	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
funa hygr	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
grim alpe	0	0	0	1	0	0	0	0	1	0	1	1	0	0	1	1	0	0	0	0	0
grim anod	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0
grim laev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim mont	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim oval	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
grim pulv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim refi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim torq torq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gymn aeru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
hama vern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
helo blan	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
herz seli	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
homa neva	0	0	0	1	0	0	0	1	1	0	0	1	0	0	1	1	0	0	0	1	1
hygr best	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
hygr luri	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr moll	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr ochr	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr tena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hylo sple	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn circ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn lind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn prat	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
hypn revo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
isop pulc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lept humi	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
lept pyri	1	1	1	0	1	1	1	1	0	1	1	0	1	1	1	0	1	1	1	0	1
lept ripa	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
lesc incu incu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc pate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc radi radi	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
lesc sten	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
limp revo	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees triq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
meta menz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
mniu ambi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mniu marg	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0
mniu spin	0	1	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	1	1	1
neck doug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth affi	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	1	1	0	0	0
orth alpe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth anom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth cupu	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
orth hall	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
orth holz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth laev	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1
orth obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
orth pell	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
orth pumi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth rupe	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
orth spec spec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
palu squa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phas cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phil font	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
phys sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phys wash	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag dent	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
plag elli	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0
plag laet	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

code	66j	67d	68e	6a	6f	6g	6j	7a	7b	7d	8a	8b	8f	9a	9c	9f	9g
ditr flex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
drep adun	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0
drep capi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
drep send	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dryp pate	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
enca cili	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca proc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
enca rhap	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0
enca vulg	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
eurh pulc pulc	0	0	0	1	1	0	1	1	1	0	1	1	0	1	1	1	1
fiss bryo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
font anti anti	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
font hypn hypn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
funa hygr	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
grim alpe	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
grim anod	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
grim laev	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
grim long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
grim mont	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim oval	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0
grim pulv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim refl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grim torq torq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gymn aeru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hama vern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
helo blan	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
herz seli	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
homa neva	0	0	0	1	1	1	1	0	0	0	1	1	0	0	1	1	1
hygr best	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr luri	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr moll	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr ochr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hygr tena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
hylo sple	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn circ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn lind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn prat	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hypn revo	0	0	0	0	1	1	1	0	0	0	0	1	0	0	1	1	1
isop pulc	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lept humi	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
lept pyri	1	1	0	1	0	1	1	1	1	1	0	0	0	1	1	0	1
lept ripa	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
lesc incu incu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc pate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lesc radi radi	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0
lesc sten	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
limp revo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mees triq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
meta menz	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	1	0
mniu ambi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mniu marg	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
mniu spin	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
neck doug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth affi	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
orth alpe	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0
orth anom	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
orth cupu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth hall	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
orth holz	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
orth laev	0	0	0	1	1	1	1	0	0	0	1	1	1	1	1	1	1
orth obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth pumi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
orth rupe	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0
orth spec spec	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
palu squa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phas cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phil font	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0
phys sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
phys wash	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag cusp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag dent	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag elli	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
plag laet	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

code	species name	author	var	var author	ssp
plag medi medi	Plagiomnium medium	(Bruch & Schimp.) T. Kop.	medium		
plag venu	Plagiomnium venustrum	(Mitt.) T. Kop.			
plat jung	Platydictya jungermannioides	(Brid.) Crum			
pleu schr	Pleurozium schreberi	(Brid.) Mitt.			
pogo urni	Pogonatum urnigerum	(Hedw.) P. Beauv.			
pohl anno	Pohlia annotina	(Hedw.) Lindb.			
pohl crud	Pohlia cruda	(Hedw.) Lindb.			
pohl drum	Pohlia drummondii	(C. Mull) Andrews			
pohl nuta	Pohlia nutans	(Hedw.) Lindb.			
pohl prol	Pohlia proligera	(Breidl.) Arnell			
pohl wahl	Pohlia wahlenbergii	(Web. & Mohr) Andrews			
poly alpi	Polytrichastrum alpinum	(Hedw.) G. L. Sm.	alpinum		
poly comm	Polytrichum commune	Hedw.	commune		
poly juni	Polytrichum juniperinum	Hedw.			
poly long	Polytrichum longisetum	Brid.			
poly lyal	Polytrichum lyallii	(Mitt.) Kindb.			
poly pili	Polytrichum piliferum	Hedw.			
poly stri	Polytrichum strictum	Brid.			
pseu revo	Pseudocrossidium revolutum	(Brid.) Zand.			
pseu tect	Pseudoleskeela tectorum	(Brid.) Kindb.			
pter fili	Pterigynandrum filiforme	Hedw.			
pter ovat	Pterygoneurum ovatum	(Hedw.) Dix.			
ptil cris	Ptilium crista-castrensis	(Hedw.) De Not.			
raco brev	Racomitrium brevipes	Kindb.			
raco cane cane	Racomitrium canescens	(Hedw.) Brid.	canescens		
raco fasc	Racomitrium fasciculare	(Hedw.) Brid.			
raco hete	Racomitrium heterostichum	(Hedw.) Brid.			
raco sude	Racomitrium sudeticum	(Funck) Bruch & Schimp.			
rhiz magn	Rhizomnium magnifolium	(Horik.) T. Kop.			
rhiz pseu	Rhizomnium pseudopunctatum	(Bruch & Schimp.) T. Kop			
rhyt robu	Rhytidiopsis robusta	(Hook.) Broth.			
rhyt triq	Rhytidiadelphus triquetrus	(Hedw.) Warnst.			
roel roel	Roellia roellii	(Broth.) Crum			
sani symm	*Sanionia symmetrica	(Ren. & Card.) Wheldon			
sani unci	Sanionia uncinata	(Hedw.) Loeske			
schi apoc	Schistidium apocarpum	(Hedw.) Bruch & Schimp.			
schi atri	*Schistidium atrichum	(C.M. et Kindb.) W.A. Weber			
schi flac	*Schistidium flaccidum	(De Not.) Ochyra			
schi stri	Schistidium strictum	(Turn.) O. Mart.			
scle obtu	Scleropodium obtusifolium	(Jaeg.) Kindb.			
scou aqua	Scouleria aquatica	Hook.			
spha fusc	Sphagnum fuscum	(Schimp.) Klinggr.			
spha russ	Sphagnum russowii	Warnst.			
spha squa	Sphagnum squarrosum	Crome			
spha tere	Sphagnum teres	(Schimp.) Angstr.			
spha warn	Sphagnum warnstorfii	Russ.			
tetr pell	Tetraphis pellucida	Hedw.			
thui reco	Thuidium recognitum	(Hedw.) Lindb.			
timm aust	Timmia austriaca	Hedw.			
timm cras	Timmiella crassinervis	(Hampe) L. Koch.			
timm mega bava	Timmia megapolitana	Hedw.	bavarica	(Hessl.) Brid.	
tome nite	Tomenthypnum nitens	(Hedw.) Loeske			
tort bart	Tortula bartramii	Steere			
tort brev	Tortula brevipes	(Lesq.) Broth.			
tort frag	Tortella fragilis	(Hook. & Wils.) Limpr.			
tort lati	Tortula latifolia	Hartm.			
tort mucr	Tortula mucronifolia	Schwaegr.			
tort prin	Tortula princeps	De Not.			
tort rura	Tortula ruralis	(Hedw.) Gaertn. et al.			
tric cyli cyli	Trichodon cylindricus	(Hedw.) Schimp.	cylindricus		
warn exan exan	Warnstorfia exannulata	(Schimp.) Loeske	exannulata		
Hepatics					
code					
anas hell	Anastrophyllum hellerianum	(Nees) R. M. Schust.			
aneu ping	Aneura pinguis	(L.) Dumort.			
aste lind	Asterella lindenbergiana	(Corda) Lindb.			
atha hyal	Athalamia hyalina	(Sommerf.) S. Hatt.			
barb barb	Barbilophozia barbata	(Schreb.) Loeske			
barb hatc	Barbilophozia hatcheri	(A. Evans) Loeske			
barb lyco	Barbilophozia lycopodioides	(Wallr.) Loeske			

code	ssp author	10a	10b	10g	10j	11a	11b	11c	11h	12a	12f	12j	13a	13b	13g	13j	14d	15a	15c	16a
plag medi medi		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
plag venu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plat jung		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
pleu schr		1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
pogo urni		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl anno		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl crud		1	1	1	0	1	0	0	1	0	1	1	0	1	0	0	0	1	0	1
pohl drum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl nuta		1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1
pohl prol		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl wahl		0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
poly alpi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly comm		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly juni		1	1	1	1	1	0	0	1	0	0	0	1	0	0	0	1	1	1	1
poly long		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly lyal		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly pili		1	0	1	0	1	0	0	0	1	1	0	1	1	0	0	0	0	0	0
poly stri		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pseu revo		0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
pseu tect		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pter fili		1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1
pter ovat		0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
ptil cris		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
raco brev		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco cane cane		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco fasc		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco hete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco sude		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhiz magn		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhiz pseu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhyt robu		1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
rhyt triq		1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1
roel roel		0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sani symm		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sani unci		0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1
schi apoc		1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0
schi atri		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi flac		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi stri		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0
scle obtu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scou aqua		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha fusc		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha russ		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha squa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha tere		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha warn		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tetr pell		0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
thui reco		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
timm aust		1	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1
timm cras		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
timm mega bava		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tome nite		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort bart		1	0	0	0	1	0	0	0	1	1	1	0	1	1	0	1	0	0	0
tort brev		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort frag		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
tort lati		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort mucr		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort prin		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort rura		1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
tric cyli cyli		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
warn exan exan		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hepatics																				
code		10a	10b	10g	10j	11a	11b	11c	11h	12a	12f	12j	13a	13b	13g	13j	14d	15a	15c	16a
anas hell		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aneu ping		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aste lind		0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atha hyal		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb barb		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb hatc		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
barb lyco		0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

code	16f	16g	17a	17b	17d	17h	18a	18b	19a	19f	19g	19h	1a	1b	1f	1g	20b	21a	21e	21f	22a
plag medi medi	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0
plag venu	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plat jung	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0
pleu schr	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0
pogo urni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl anno	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl crud	1	1	1	1	0	1	1	1	1	0	0	0	1	1	0	0	1	1	0	1	1
pohl drum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl nuta	0	1	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	1	1	1	1
pohl prol	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl wahl	0	0	0	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0
poly alpi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly comm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
poly juni	0	1	1	1	1	1	1	1	0	0	0	1	1	0	0	0	0	0	1	1	1
poly long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly lyal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly pili	0	0	1	0	0	1	0	0	1	1	1	0	1	0	1	1	0	0	0	0	1
poly stri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
pseu revo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pseu tect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pter fili	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0
pter ovat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil cris	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
raco brev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco cane cane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco fasc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco hete	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco sude	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhiz magn	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
rhiz pseu	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
rhyt robu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhyt triq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
roel roel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sani symm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sani unci	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0
schi apoc	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi atri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi flac	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
schi stri	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scle obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scou aqua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha fusc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
spha russ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha squa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha tere	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha warn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
tetr pell	0	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0
thui reco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
timm aust	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1	0
timm cras	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
timm mega bava	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tome nite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
tort bart	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0
tort brev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort frag	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort lati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort mucr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort prin	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
tort rura	1	0	1	1	0	1	0	0	1	1	1	1	1	1	1	1	1	0	1	1	0
tric cyli cyli	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
warn exan exan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hepatics																					
code	16f	16g	17a	17b	17d	17h	18a	18b	19a	19f	19g	19h	1a	1b	1f	1g	20b	21a	21e	21f	22a
anas hell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aneu ping	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
aste lind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atha hyal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb barb	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb hatc	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
barb lyco	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

code	22f	23a	24a	24b	24c	24f	25a	26a	27b	28a	28c	28e	28f	29a	29b	29f	29g	2a	2j	30a	31a
plag medi medi	0	0	0	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0
plag venu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plat jung	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
pleu schr	0	0	1	0	1	0	0	0	1	1	1	0	0	0	1	0	1	0	0	0	0
pogo urni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl anno	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl crud	1	1	1	0	0	1	1	1	1	1	0	0	1	1	1	1	1	0	1	1	1
pohl drum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl nuta	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1
pohl prol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
pohl wahl	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
poly alpi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
poly comm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly juni	1	1	1	1	1	1	1	0	1	1	1	0	1	1	0	0	1	1	1	1	1
poly long	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
poly lyal	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	1
poly pili	1	0	1	0	1	1	1	1	0	0	0	0	1	1	0	0	1	1	1	1	1
poly stri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pseu revo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pseu tect	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pter fili	1	1	1	1	0	1	0	0	1	1	1	0	1	1	1	1	1	0	0	1	0
pter ovat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
ptil cris	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0
raco brev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco cane cane	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
raco fasc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
raco hete	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
raco sude	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhiz magn	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
rhiz pseu	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
rhyt robu	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0	1	0	0	0	1
rhyt triq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
roel roel	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
sani symm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sani unci	0	0	1	0	1	0	0	0	1	1	1	0	0	1	1	1	1	0	0	0	0
schi apoc	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi atri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi flac	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi stri	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
scle obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scou aqua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha fusc	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
spha russ	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
spha squa	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
spha tere	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
spha warn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tetr pell	0	1	0	1	1	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0
thui reco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
timm aust	1	0	1	1	0	1	0	0	1	1	0	0	0	1	1	1	1	0	0	1	0
timm cras	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
timm mega bava	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tome nite	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
tort bart	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
tort brev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort frag	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort lati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort mucr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort prin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort rura	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	0	1	1	1	0
tric cyli cyli	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
warn exan exan	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Hepatics																					
code	22f	23a	24a	24b	24c	24f	25a	26a	27b	28a	28c	28e	28f	29a	29b	29f	29g	2a	2j	30a	31a
anas hell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aneu ping	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
aste lind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atha hyal	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
barb barb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb hatc	0	0	1	0	0	0	1	0	0	0	0	0	0	1	1	1	1	0	0	0	0
barb lyco	0	0	1	0	0	0	0	0	0	1	0	0	0	1	1	1	1	0	0	0	0

code	31b	32a	33c	33d	34a	34c	34d	35f	35g	35j	36d	36e	37a	37j	38a	38c	39a	3a	3b	40h	41a
plag medi medi	1	0	0	0	0	1	1	0	0	1	1	0	0	1	1	0	0	0	0	1	0
plag venu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plat jung	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
pleu schr	0	0	0	0	1	0	1	0	0	0	1	1	1	1	1	0	0	0	0	1	1
pogo urni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl anno	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl crud	1	1	1	1	0	0	0	0	1	0	0	0	1	1	0	1	1	0	0	1	1
pohl drum	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
pohl nuta	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
pohl prol	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl wahl	1	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	1	0
poly alpi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly comm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly juni	1	1	1	1	1	0	0	1	1	1	1	0	1	1	1	1	1	1	0	1	1
poly long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly lyal	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly pili	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0
poly stri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pseu revo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pseu tect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
pter fili	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
pter ovat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil cris	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
raco brev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco cane cane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco fasc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco sude	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhiz magn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhiz pseu	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
rhyt robu	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
rhyt triq	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	1
roel roel	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1
sani symm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sani unci	1	1	1	0	1	0	1	0	1	0	0	1	1	1	1	1	0	0	0	1	0
schi apoc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
schi atri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi flac	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi stri	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scle obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scou aqua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha fusc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha russ	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
spha squa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha tere	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha warn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tetr pell	0	0	1	0	0	0	1	0	0	1	1	1	1	1	1	0	0	0	0	1	1
thui reco	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
timm aust	1	0	1	0	0	0	0	0	1	0	0	0	1	1	1	1	1	0	1	1	0
timm cras	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
timm mega bava	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
tome nite	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
tort bart	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
tort brev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort frag	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort lati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort mucr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort prin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort rura	0	1	0	0	1	1	0	1	1	0	0	1	0	1	1	1	1	1	1	1	0
tric cyli cyli	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
warn exan exan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hepatics																					
code	31b	32a	33c	33d	34a	34c	34d	35f	35g	35j	36d	36e	37a	37j	38a	38c	39a	3a	3b	40h	41a
anas hell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aneu ping	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aste lind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atha hyal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb barb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb hatc	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
barb lyco	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

code	42a	42c	43a	43c	44a	45a	45b	46a	47a	47b	47e	48a	48g	49b	4a	4c	4f	50a	50d	51a	52a
plag medi medi	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
plag venu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plat jung	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
pleu schr	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	1	1
pogo urni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
pohl anno	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
pohl crud	1	1	1	0	1	0	0	1	0	1	0	1	1	0	1	0	1	0	0	1	1
pohl drum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl nuta	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1
pohl prol	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
pohl wahl	0	1	1	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
poly alpi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly comm	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
poly juni	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	1	0	1	1
poly long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly lyal	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1
poly pili	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1	0	0	1	1
poly stri	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
pseu revo	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pseu tect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pter fili	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
pter ovat	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil cris	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0
raco brev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
raco cane cane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco fasc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco sude	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
rhiz magn	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
rhiz pseu	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
rhyt robu	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	1	1
rhyt triq	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
roel roel	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0
sani symm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sani unci	0	0	0	0	1	0	0	1	0	1	1	0	1	1	0	0	0	1	1	1	1
schi apoc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi atri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi flac	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
schi stri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scle obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scou aqua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha fusc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha russ	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
spha squa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha tere	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
spha warn	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
tetr pell	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	1	0	0	0
thui reco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
timm aust	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0	1	0
timm cras	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
timm mega bava	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tome nite	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
tort bart	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
tort brev	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort frag	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort lati	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort mucr	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort prin	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
tort rura	1	0	1	0	1	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0
tric cyli cyli	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
warn exan exan	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Hepatics																					
code	42a	42c	43a	43c	44a	45a	45b	46a	47a	47b	47e	48a	48g	49b	4a	4c	4f	50a	50d	51a	52a
anas hell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aneu ping	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
aste lind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atha hyal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb barb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb hatc	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0
barb lyco	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0

code	53e	54a	54b	55a	56e	57j	58b	59a	5a	5c	5h	60a	60c	60h	61c	61f	62d	63b	64b	65f	65h
plag medi medi	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0
plag venu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plat jung	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	1	1	0
pleu schr	0	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0
pogo urni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl anno	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl crud	0	1	1	1	0	1	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0
pohl drum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl nuta	0	1	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	0	1
pohl prol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl wahl	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	1	0
poly alpi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly comm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly juni	1	1	0	1	0	1	0	1	1	0	1	1	0	0	0	0	1	1	0	0	1
poly long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly lyal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly pili	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
poly stri	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pseu revo	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
pseu tect	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0
pter fili	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
pter ovat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil cris	0	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
raco brev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco cane cane	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco fasc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco sude	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhiz magn	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0
rhiz pseu	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhyt robu	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
rhyt triq	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1
roel roel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sani symm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
sani unci	0	1	1	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	1	0	1
schi apoc	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
schi atri	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
schi flac	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi stri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0
scle obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scou aqua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha fusc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha russ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha aqua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha tere	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha warn	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tetr pell	0	1	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0
thui reco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
timm aust	0	1	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0	1	1	1	0
timm cras	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
timm mega bava	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
tome nite	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort bart	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort brev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort frag	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
tort lati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort mucr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
tort prin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort rura	1	1	0	1	0	0	0	1	1	0	0	1	1	1	1	1	0	1	0	1	0
tric cyli cyli	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
warn exan exan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hepatics																					
code	53e	54a	54b	55a	56e	57j	58b	59a	5a	5c	5h	60a	60c	60h	61c	61f	62d	63b	64b	65f	65h
anas hell	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aneu ping	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
aste lind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atha hyal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb barb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb hatc	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb lyco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

code	66j	67d	68e	6a	6f	6g	6j	7a	7b	7d	8a	8b	8f	9a	9c	9f	9g
plag medi medi	0	1	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0
plag venu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plat jung	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0
pleu schr	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
pogo urni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl anno	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl crud	1	0	0	1	1	0	0	1	1	0	1	0	0	0	1	1	1
pohl drum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl nuta	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	0	1
pohl prol	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pohl wahl	0	1	0	0	0	0	1	0	1	1	0	0	0	0	1	0	0
poly alpi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly comm	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly juni	1	1	0	1	0	1	0	1	1	0	0	0	0	1	1	1	1
poly long	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly lyal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
poly pili	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
poly stri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pseu revo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pseu tect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
pter fili	0	0	0	1	0	1	1	0	0	0	0	0	0	0	1	1	1
pter ovat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil cris	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
raco brev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco cane cane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco fasc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
raco sude	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhiz magn	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhiz pseu	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rhyt robu	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
rhyt triq	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
roel roel	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0
sani symm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sani unci	1	1	1	1	0	0	1	0	1	0	0	1	0	1	0	0	0
schi apoc	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0
schi atri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi flac	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
schi stri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scle obtu	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
scou aqua	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
spha fusc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha russ	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha aqua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha tere	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
spha warn	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tetr pell	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
thui reco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
timm aust	1	0	0	0	1	0	1	0	1	0	0	1	0	0	1	1	1
timm cras	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
timm mega bava	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
tome nite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort bart	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort brev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort frag	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort lati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort mucr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
tort prin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tort rura	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1
tric cyli cyli	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
warn exan exan	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hepatica																	
code	66j	67d	68e	6a	6f	6g	6j	7a	7b	7d	8a	8b	8f	9a	9c	9f	9g
anas hell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aneu ping	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aste lind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atha hyal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb barb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
barb hatc	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
barb lyco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

code	species name	author	var	var author	ssp
blep tric	Blepharostoma trichophyllum	(L.) Dumort.			
caly muel	Calypogeia muelleriana	(Schiffn.) Mull. Frib.			
caly nees	Calypogeia neesiana	(C. Massal. & Carestia) Mull. Frib.			
caly spha	Calypogeia sphagnicola	(Arnell & J. Perss.) Warnst. & Loeske			
ceph conn	Cephalozia connivens	(Dicks.) Lindb.			
ceph diva	Cephaloziella divaricata	(Sm.) Schiffn.			
ceph lunu	Cephalozia lunulifolia	(Dumort.) Dumort.			
ceph plen	Cephalozia pleniceps	(Austin) Lindb.			
ceph rube	Cephaloziella rubella	(Nees) Warnst.			
ceph spin	Cephaloziella spinigera	(Lindb.) Jorg.			
chil pall	Chiloscyphus pallescens	(Hoffm.) Dumort.			
chil poly	Chiloscyphus polyanthos	(L.) Corda			
cono coni	Conocephalum conicum	(L.) Dumort.			
frul bola	Frullania bolanderi	Aust.			
geoc grav	Geocalyx graveolens	(Schrad.) Nees			
gymn infl	Gymnocolea inflata	(Huds.) Dumort.			
harp flot	Harpanthus flotovianus	(Nees) Nees			
jung exse cord	Jungermannia exsertifolia	Steph.			cordifolia
lepi rept	Lepidozia reptans	(L.) Dumort.			
loph asce	Lophozia ascendens	(Warnst.) R. M. Schust.			
loph bide	Lophocolea bidentata	(L.) Dumort.			
loph exci	Lophozia excisa	(Dicks.) Dumort.			
loph inci	Lophozia incisa	(Schrad.) Dumort.			
loph longid	Lophozia longidens	(Lindb.) Macoun			
loph longif	Lophozia longiflora	(Nees) Schiffn.			
loph mino	Lophocolea minor	Nees			
loph obtu	Lophozia obtusa	(Lindb.) A. Evans			
loph sude	Lophozia sudetica	(Huebener) Grolle			
loph vent	Lophozia ventricosa	(Dicks.) Dumort.			
lophoc hete	Lophocolea heterophylla	(Schrad.) Dumort.			
lophoz hete	Lophozia heterocolpos	(Hartm.) M. Howe			
marc poly	Marchantia polymorpha	L.			
pell endi	Pellia endiviifolia	(Dicks.) Dumort.			
plag pore	Plagiochila porelloides	(Nees) Lindenb.			
pore cord	Porella cordaeana	(Huebener) Moore			
ptil cali	Ptilidium californicum	(Austin) Pearson			
ptil pulc	Ptilidium pulcherrimum	(Weber) Vainio			
radu comp	Radula complanata	(L.) Dumort.			
ricc cave	Riccia cavernosa	Hoffm.			
ricc fros	Riccia frostii	Austin			
ricc lati	Riccardia latifrons	(Lindb.) Lindb.			
ricc mult	Riccardia multifida	(L.) Gray			
ricc palm	Riccardia palmata	(Hedw.) Carruth.			
scap curt	Scapania curta	(Mart.) Dumort.			
scap irri	Scapania irrigua	(Nees) Gottsche & Lindenb. & Nees			
scap mucr	Scapania mucronata	H. Buch.			
scap umbr	Scapania umbrosa	(Schrad.) Dumort.			
scap undu	Scapania undulata	(L.) Dumort.			
targ hypo	Targionia hypophylla	L.			
trit exse	Tritomaria exsectiformis	(Breidl.) Loeske			

code	ssp author	10a	10b	10g	10j	11a	11b	11c	11h	12a	12f	12j	13a	13b	13g	13j	14d	15a	15c	16a
blep tric		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly muel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly nees		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly apha		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph conn		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
ceph diva		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph lunu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph plen		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
ceph rube		1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
ceph spin		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
chil pall		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
chil poly		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
cono coni		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
frul bola		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
geoc grav		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gymn infl		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
harp flot		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
jung exse cord	Vana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lepi rept		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
loph asce		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
loph bide		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
loph exci		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
loph inci		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
loph longid		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
loph longif		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph mino		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph obtu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph sude		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph vent		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
lophoc hete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
lophoz hete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
marc poly		0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
pell endi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
plag pore		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
pore cord		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil cali		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil pulc		0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
radu comp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc cave		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc fros		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc lati		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
ricc mult		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc palm		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap curt		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap irri		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap mucr		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
scap umbr		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap undu		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
larg hypo		0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
trit exse		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1

code	16f	16g	17a	17b	17d	17h	18a	18b	19a	19f	19g	19h	1a	1b	1f	1g	20b	21a	21e	21f	22a
blep tric	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
caly muel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
caly nees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly spha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph conn	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
ceph diva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph lunu	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
ceph plen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph rube	0	1	1	0	0	0	1	1	1	0	0	0	1	0	0	0	0	1	1	1	1
ceph spin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
chil pall	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0
chil poly	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
cono coni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
frul bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
geoc grav	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0
gymn infl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
harp flot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
jung exse cord	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
lepi rept	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
loph asce	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph bide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph exci	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph inci	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0
loph longid	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0
loph longif	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
loph mino	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	1	0
loph obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph sude	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph vent	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0
lophoc hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lophoz hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
marc poly	0	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0
pell endi	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0
plag pore	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0
pore cord	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
ptil cali	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
ptil pulc	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0
radu comp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc cave	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc fros	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc lati	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
ricc mult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc palm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
scap curt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap irri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap mucr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap umbr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap undu	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
targ hypo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
trit exse	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0

code	22f	23a	24a	24b	24c	24f	25a	26a	27b	28a	28c	28e	28f	29a	29b	29f	29g	2a	2j	30a	31a
blep tric	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
caly muel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly nees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly spha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph conn	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
ceph diva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph lunu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
ceph plen	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ceph rube	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	0	0	1	1
ceph spin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
chil pall	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
chil poly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cono coni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
frul bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
geoc grav	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
gymn infl	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
harp flot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
jung exse cord	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lepi rept	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
loph asce	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph bide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph exci	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph inci	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0
loph longid	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0
loph longif	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
loph mino	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	0	0	0	0	0
loph obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph sude	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0
loph vent	0	0	1	0	1	0	0	1	1	1	1	0	0	1	1	0	1	0	0	0	1
lophoc hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lophoz hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
marc poly	0	0	0	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1
pell endi	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
plag pore	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
pore cord	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
ptil cali	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
ptil pulc	0	1	1	1	1	0	0	0	1	0	1	0	0	0	1	1	1	0	0	0	0
radu comp	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0
ricc cave	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
ricc fros	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc lati	0	0	0	0	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0
ricc mult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc palm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap curt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap irri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap mucr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap umbr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
scap undu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
targ hypo	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
trit exse	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0

code	31b	32a	33c	33d	34a	34c	34d	35f	35g	35j	36d	36e	37a	37j	38a	38c	39a	3a	3b	40h	41a
blep tric	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
caly musl	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
caly nees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly spha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph conn	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0
ceph diva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph lunu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph plen	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
ceph rube	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	1	1	0
ceph spin	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
chil pall	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0
chil poly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cono coni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
frul bola	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
geoc grav	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
gymn infl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
harp flot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
jung exse cord	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lepi rept	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
loph asce	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
loph bide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph exci	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0
loph inci	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
loph longid	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
loph longif	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
loph mino	1	0	1	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0
loph obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph sude	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph vent	1	0	1	0	1	1	1	0	0	0	1	1	0	1	1	1	0	0	0	1	0
lophoc hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lophoz hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
marc poly	1	0	0	1	0	1	1	0	0	0	1	1	0	1	0	1	0	0	1	1	0
pell endi	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
plag pore	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pore cord	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil cali	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil pulc	0	0	0	0	0	0	1	0	1	0	1	1	1	1	1	0	0	0	0	1	0
radu comp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc cave	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc fros	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc lati	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
ricc mult	0	0	0	0	0	1	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0
ricc palm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap curt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap irri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap mucr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap umbr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap undu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
targ hypo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
trit exse	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0

code	42a	42c	43a	43c	44a	45a	45b	46a	47a	47b	47e	48a	48g	49b	4a	4c	4f	50a	50d	51a	52a
blep tric	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
caly muel	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
caly nees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly spha	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
ceph conn	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
ceph diva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph lunu	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0
ceph plen	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0
ceph rube	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	1	1
ceph spin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
chil pall	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0
chil poly	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
cono coni	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
frul bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
geoc grav	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
gymn infl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
harp flot	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
jung exse cord	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
lepi rept	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0
loph asce	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
loph bide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
loph exci	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph inci	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0
loph longid	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0
loph longif	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0
loph mino	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1
loph obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
loph sude	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
loph vent	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	1	1
lophoc hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
lophoz hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
marc poly	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	1	0	1
pell endi	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	1	0	1
plag pore	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
pore cord	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil cali	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil pulc	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0
radu comp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc cave	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc fros	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc lati	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
ricc mult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ricc palm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap curt	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
scap irri	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
scap mucr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap umbr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap undu	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
targ hypo	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
trit exse	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0

code	53e	54a	54b	55a	56e	57j	58b	59a	5a	5c	5h	60a	60c	60h	61c	61f	62d	63b	64b	65f	65h
blep tric	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly muel	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly nees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly spha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph conn	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph diva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph lunu	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ceph plen	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph rube	0	1	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0
ceph spin	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
chil pall	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0
chil poly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cono coni	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0
frul bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
geoc grav	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
gymn infl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
harp flot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
jung exse cord	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lepi rept	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
loph asce	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
loph bide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph exci	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph inci	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
loph longid	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
loph longif	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph mino	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1	0	1	1	0
loph obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph sude	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph vent	0	1	0	0	1	1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0
lophoc hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lophoz hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
marc poly	1	0	1	0	1	0	1	0	0	0	0	0	0	1	1	0	1	1	1	0	1
pell endi	1	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0
plag pore	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0
pore cord	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil cali	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil pulc	0	1	1	0	1	1	1	0	0	0	0	0	0	1	1	0	1	1	1	0	1
radu comp	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc cave	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc fros	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc lati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc mult	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc palm	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
scap curt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap irri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap mucr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap umbr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap undu	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
targ hypo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
trit exse	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0

code	66j	67d	68e	6a	6f	6g	6j	7a	7b	7d	8a	8b	8f	9a	9c	9f	9g
blep tric	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly muel	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly nees	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
caly spha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph conn	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph diva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph lunu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph plen	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ceph rube	0	0	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0
ceph spin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
chil pall	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
chil poly	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cono coni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
frul bola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
geoc grav	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gymn infl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
harp flot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
jung exse cord	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lepi rept	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph asce	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph bide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph exci	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph inci	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph longid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph longif	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph mino	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph obtu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph surde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
loph vent	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lophoc hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lophoz hete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
marc poly	1	1	1	0	0	0	1	0	1	1	0	0	0	1	1	0	0
pell endi	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
plag pore	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pore cord	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0
ptil cali	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ptil pulc	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
radu comp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc cave	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc fros	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc lati	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc mult	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ricc palm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap curt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap irri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap mucr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap umbr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scap undu	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
targ hypo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
trit exse	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix C. Environmental data for 141 sites in the study area collected during the summer of 2000. Codes, descriptions and methods for the environmental variables follow Table 3-1.

site	slope	elev	northing	easting	soil	rock	water	text	rough	microt	stable	lit_thick	lit_cov	lit_type	moist	organic
10a	29.2	3975	-0.63306	-0.7741	63	38	0	2	4	2	3	2.9	38	2	2	14.08
10b	17.4	3897	0.145172	0.989406	83	5	5	1	3	2	2	1	38	2	3	7.92
10g	32.2	3936	-0.91488	0.403734	5	83	0	2	4	3	4	0.6	18	3	2	73.13
10j	17	3900	-0.28334	-0.95902	95	5	0	2	4	2	2	4.6	38	2	3	47.5
11a	7.8	3437	0.995237	0.097482	95	5	0	2	5	2	1	1.2	18	1	1	18.81
11b	2	3444	0.686267	0.727349	63	18	5	2	3	2	1	7.1	38	1	3	34.65
11c	0	3395	-0.48742	0.873165	38	5	63	2	4	2	1	8	63	1	3	9.55
11h	18	3651	0.891869	0.452295	95	0	0	2	4	2	1	2.3	38	1	2	25.37
12a	13	3037	-0.60574	0.79566	83	18	0	1	4	3	1	1.7	18	1	1	3.96
12f	74.2	3424	0.944084	-0.32971	5	83	0	2	4	4	1	1.3	5	3	1	10.05
12j	7.8	3234	-0.26638	-0.96387	63	18	5	2	4	3	1	3.2	38	2	2	26.47
13a	7.2	2303	-0.97749	-0.21099	83	18	0	1	4	3	1	0.6	18	1	1	2.5
13b	11.8	2188	0.119001	0.992894	63	38	5	2	4	4	1	0.9	18	1	2	7.04
13g	28.8	2411	-0.17151	-0.98518	18	83	0	1	4	3	4	0.9	5	1	1	14.63
13j	20	2381	0.946936	-0.32142	83	5	0	2	4	2	1	2.5	63	2	2	18.72
14d	1.4	2768	-0.96719	-0.25406	63	5	38	2	2	1	2	5.8	63	1	4	63.9
15a	26.6	2781	-0.77093	-0.63692	83	5	0	2	3	3	1	2.9	38	2	3	61.08
15c	19.6	2768	-0.96719	-0.25406	5	5	83	2	3	2	3	1.3	38	2	3	43.35
16a	34.2	2919	-0.89586	-0.44433	83	18	0	2	5	3	3	2.5	63	2	2	29
16f	78	2919	-0.89586	-0.44433	18	83	0	2	4	4	2	4.2	38	1	2	16.02
16g	33.8	2795	0.525527	-0.85078	18	83	0	2	5	3	4	1.9	38	2	2	80.79
17a	7.6	4244	-0.95776	0.287557	83	18	0	2	4	4	1	2.4	38	2	2	17.33
17b	10	4238	-0.99996	0.00849	63	18	18	2	3	3	2	1.65	63	2	3	6.4
17d	6.4	4044	-0.71773	-0.69632	83	5	5	2	4	3	2	1	18	1	3	29.15
17h	7.25	4194	-0.99966	0.02619	83	5	5	2	4	3	2	1.4	63	2	3	83.25
18a	28.6	4182	-0.85762	-0.51429	83	18	0	2	4	3	1	2.4	63	2	3	28.64
18b	9	4179	0.776458	0.630169	63	18	18	2	3	2	1	1.6	38	2	4	47.29
19a	23.6	2618	-0.49469	-0.86907	38	38	0	1	3	2	2	1.3	38	2	1	9.45
19f	44.8	2814	0.647103	-0.7624	5	83	0	1	4	5	2	0.3	5	1	1	13.3
19g	38.8	2778	0.673329	0.739343	5	95	0	1	4	3	4	0.7	5	1	1	35.47
19h	16.2	2758	0.949753	-0.313	83	18	0	1	3	1	2	7.2	83	2	2	29.5
1a	27.6	1919	-0.87122	0.49089	63	18	0	1	4	3	3	1.2	63	3	2	17.91
1b	0.8	1791	0.957616	0.288048	18	5	5	2	2	3	3	1.5	18	3	3	15.3
1f	56.2	1978	0.359213	-0.93326	5	63	0	2	4	5	3	0.4	5	2	2	13.37
1g	19.8	1975	-0.48732	0.873224	5	63	0	2	4	4	4	3.1	38	1	2	13.37
20b	6.6	2259	-0.98107	-0.19365	63	38	5	2	1	2	2	1.82	63	1	3	16.42
21a	23.8	3759	-0.08429	0.996441	95	5	0	2	3	2	2	7.1	95	2	3	18
21e	10.2	3788	0.724326	-0.68946	83	18	5	1	3	3	1	3	83	2	4	10.5
21f	77.4	3746	0.342183	0.939633	5	95	0	1	3	4	2	0.04	5	2	2	6.9
22a	14.8	4772	-0.99686	0.079158	83	5	0	1	3	2	1	3.6	95	2	2	3.92
22f	54	4920	0.964855	0.262782	5	83	0	1	4	5	2	1.2	5	1	2	9.36
23a	14.8	4779	-0.80354	-0.59525	95	5	0	1	3	2	1	4.1	83	2	2	5.42
24a	11.6	4353	0.317772	-0.94817	83	5	0	1	4	3	1	1.56	38	2	3	36.82
24b	6.6	4303	0.555414	-0.83157	63	38	5	2	4	3	1	0.42	5	2	5	11.71
24c	0	4362	0.101226	0.994863	38	5	63	2	5	3	1	0.42	18	2	5	16
24f	47.2	4405	0.883694	0.468065	38	63	0	1	5	4	2	1.02	38	2	2	46.04
25a	23.6	7258	0.605048	0.796189	38	63	0	1	5	3	3	1.64	38	3	2	14.95
26a	14.8	7085	-0.7593	-0.65075	83	18	0	2	5	2	2	0.58	38	3	3	42.08
27b	4	4026	0.048995	-0.9988	63	5	38	2	3	2	3	0.48	38	2	4	58.71
28a	15	4077	0.705786	-0.70843	95	5	0	2	4	5	2	1.48	83	2	3	27.23
28c	0	4180	-0.11075	0.993849	83	5	5	2	4	2	2	1.18	18	1	5	46.73
28e	0	4130	-0.36763	0.929973	83	0	5	3	4	2	2	1.66	38	1	5	85
28f	54	4210	0.964871	0.262724	38	63	0	1	5	5	4	1.82	38	2	2	13.86
29a	23	4308	-0.63987	-0.76849	38	63	0	1	4	3	2	1.28	38	2	2	11.65
29b	13.8	4197	0.985957	-0.167	38	63	0	3	4	3	3	1.24	38	2	3	80.1
29f	56.4	4197	0.985957	-0.167	5	83	0	1	4	5	4	0.6	5	2	4	9.5
29g	37.8	4260	1	0.000362	5	95	0	3	4	3	5	0.82	5	2	2	83.58
2a	10.6	2129	0.540454	-0.84137	83	18	0	2	4	3	3	1	5	1	1	7.32
2j	6.25	2214	-0.68016	0.733067	38	63	0	2	4	4	2	2	18	1	3	8.96
30a	19.2	5875	0.975517	0.219925	38	38	0	2	4	4	4	1.88	63	3	2	21.67
31a	15.8	5550	-0.36774	0.929929	95	5	0	1	3	2	2	2.42	63	2	2	8.46
31b	11	5550	-0.36774	0.929929	63	5	18	2	3	3	2	0.92	18	2	4	64.5
32a	19.6	4310	0.965061	-0.26203	83	18	0	1	4	3	2	1.62	63	2	2	42.08
33c	0	5105	-0.99613	0.087948	38	5	38	3	5	3	3	1.32	18	2	4	30.2
33d	0	5105	-0.99613	0.087948	83	0	5	3	5	3	3	0.4	5	1	5	81.77
34a	17	4440	-0.59817	-0.80137	83	18	0	1	4	3	3	0.68	63	2	2	10.89
34c	0	4400	-0.19817	0.980168	63	5	38	2	5	3	1	1.08	38	2	4	18.5
34d	1.6	4445	-0.93813	0.346282	95	5	5	2	5	3	2	0.1	18	1	4	55.22
35f	74.4	4261	0.539998	0.841666	18	63	0	1	4	5	3	2.28	18	2	2	7.96
35g	28.2	4100	-0.97555	-0.21978	5	95	0	1	4	4	5	1	5	3	1	43.72
35j	1	4060	0.486872	0.873473	95	0	0	2	4	4	2	3.52	83	1	4	55.67
36d	1.4	3560	-0.83891	-0.54427	83	5	18	2	3	3	1	4.2	63	1	5	47.76

site	inorgan	pH_soil	dwd_cov	densio	con_cov	dec_cov	shrub_cov	herb_cov	bryo_cov	hab_het	per_occ
10a	0	5.34	5	37.64	38	0	18	63	5	27	40.74074
10b	0.5	5.61	18	61.16	18	38	38	63	18	30	56.66667
10g	2.99	5.29	5	6.24	5	0	5	5	5	24	37.5
10j	1	5.34	5	51.78	18	38	63	38	5	29	68.96552
11a	0	5.67	0	0	0	0	5	95	5	7	57.14286
11b	10.89	7.33	38	33.26	5	18	38	63	18	21	76.19048
11c	1.01	6.82	0	0	0	0	5	95	5	10	40
11h	1.99	6.4	18	34.52	0	38	38	83	5	14	42.85714
12a	0.5	6.45	5	17.48	5	0	38	38	5	30	33.33333
12f	1.01	5.37	0	31.4	5	0	5	5	5	11	81.81818
12j	0.98	6.84	5	50.12	18	18	18	38	5	27	59.25926
13a	1	7.76	5	0	0	0	38	63	5	14	71.42857
13b	2.51	7.51	5	31.66	5	18	38	38	5	28	50
13g	1.46	5.84	5	6.66	5	0	38	38	5	20	25
13j	1.48	7.32	18	62.42	5	63	63	63	5	22	45.45455
14d	1.46	6.73	18	56.58	18	63	38	83	18	47	65.95745
15a	0.99	4.53	18	64.06	63	5	18	38	38	33	81.81818
15c	1.97	6.65	18	46.16	38	18	38	38	38	33	81.81818
16a	2	6	18	58.86	63	5	63	63	18	31	58.06452
16f	0.97	5.95	5	48.68	5	0	38	18	63	18	88.88889
16g	1.97	5.19	18	14.78	18	5	18	18	38	25	72
17a	0.5	5.48	18	19.12	18	0	18	83	5	35	54.28571
17b	0.49	5.63	38	65.3	18	38	5	38	18	34	70.58824
17d	1.51	6.17	18	0.84	5	5	38	63	18	45	77.77778
17h	2.46	6.55	38	66.78	5	63	63	38	5	31	77.41935
18a	0.5	4.92	18	52.64	63	0	5	63	5	31	67.74194
18b	0.49	4.93	18	63.64	38	5	5	63	18	33	81.81818
19a	0.5	5.18	18	3	5	0	38	38	5	29	31.03448
19f	0	5.27	5	13.26	5	5	5	5	18	15	86.66667
19g	1.48	5.8	5	2.2	5	5	5	5	5	10	50
19h	1.5	5.22	5	75.46	5	38	83	38	5	20	45
1a	0.5	4.44	5	14.37	5	0	5	38	5	16	43.75
1b	1	4.44	18	35.44	5	18	63	38	5	25	60
1f	0.99	5.67	5	8.12	5	0	18	18	5	18	61.11111
1g	0.99	5.67	38	19.36	5	0	63	38	5	26	42.30769
20b	0.5	5.62	18	89.2	18	63	38	18	5	33	81.81818
21a	0.5	4.17	5	84.32	83	5	5	38	38	37	56.75676
21e	0.5	4.75	5	67.8	18	18	38	18	63	45	64.44444
21f	0	4.77	5	82.95	63	5	5	5	18	28	57.14286
22a	0.98	5.75	18	31.43	18	5	5	83	5	49	36.73469
22f	0	6.24	5	26	5	0	5	5	5	38	28.94737
23a	0	5.27	18	75.02	63	5	18	83	5	42	59.52381
24a	1	4.81	18	64.36	83	0	18	38	5	29	75.86207
24b	0.5	5.57	18	53	5	18	38	38	5	21	66.66667
24c	0.5	5.17	18	31.9	5	18	5	63	18	30	93.33333
24f	0.5	4.83	5	51.14	38	5	5	38	5	24	54.16667
25a	0	3.95	18	13.72	18	0	38	5	5	22	50
26a	0	3.28	18	30.1	38	0	83	5	5	23	21.73913
27b	1	5.09	38	78.7	63	5	38	63	18	32	62.5
28a	0.99	4.66	38	76.74	63	5	38	38	18	33	75.75758
28c	2.01	5.22	18	26.52	38	18	18	83	18	34	88.23529
28e	2	5.7	0	0	5	0	5	83	83	4	50
28f	0.5	5.89	5	55.78	18	0	38	38	5	25	40
29a	0.49	4.83	38	38.22	18	0	18	38	18	24	50
29b	1	3.58	38	70.72	63	5	18	5	63	33	84.84848
29f	1	4.13	5	82.02	63	5	5	5	18	21	61.90476
29g	0.5	3.47	5	28.06	5	5	5	5	38	22	77.27273
2a	0.49	5.8	5	0	0	0	18	83	5	17	58.82353
2j	7.46	7.78	5	23.72	5	0	83	18	5	18	72.22222
30a	0.49	4.14	38	67.44	63	0	5	5	5	24	45.83333
31a	0.5	4.6	18	51.12	38	0	18	83	5	28	35.71429
31b	1	5.19	18	76.42	63	0	5	38	38	26	80.76923
32a	0.99	5.46	18	16.92	18	0	38	63	5	35	40
33c	0.99	4.91	63	54.18	63	5	18	18	5	32	50
33d	1	6.5	0	0	0	0	0	83	63	1	100
34a	0.5	5.44	18	39.78	38	0	18	63	5	34	61.76471
34c	1.5	6.04	38	20.64	18	5	5	63	38	29	86.2069
34d	2.99	6.05	18	56.42	5	63	5	83	18	24	91.66667
35f	0.5	5.8	5	66.66	18	0	18	18	5	15	60
35g	0.5	3.43	5	15.12	5	0	5	5	5	18	38.88889
35j	1.48	5.32	18	94.8	0	63	63	18	5	20	80
36d	2.49	6.2	5	5.62	5	5	18	83	18	26	80.76923

site	slope	elev	northing	easting	soil	rock	water	text	rough	microt	stable	lit_thick	lit_cov	lit_type	moist	organic
36e	2	3541	-0.91101	-0.41239	95	0	0	2	3	3	1	2	38	2	4	79.4
37a	15	4025	-0.81399	-0.58088	83	5	0	2	4	2	2	2.9	38	1	3	41.87
37j	6	4045	0.198139	-0.98017	83	5	5	2	3	3	2	0.9	38	1	4	19.9
38a	10.6	4106	-0.9981	0.061559	95	5	0	2	4	3	2	1.7	63	2	2	59.41
38c	0	4060	0.486872	0.873473	63	5	38	1	3	3	3	0.5	38	1	4	31.5
39a	14.4	4340	-0.11003	-0.99393	63	38	0	1	4	3	3	1.7	38	1	1	22.55
3a	14.6	3257	-0.67371	0.738998	83	18	0	2	3	3	2	0.75	18	1	2	3.48
3b	3.6	3093	-0.10186	0.994799	83	5	5	2	3	1	3	1.9	18	1	3	23.65
40h	15.2	4540	-0.9216	-0.38814	95	5	5	2	4	2	3	2.7	83	1	3	71
41a	12.8	4506	0.576682	0.816969	95	0	0	2	4	2	2	1.7	83	2	3	73.76
42a	0.8	922	-0.05741	-0.99835	95	0	5	2	3	3	3	1.1	63	1	3	22.17
42c	8.2	945	-0.81423	0.580538	5	0	83	1	3	3	2	0.22	5	1	5	5.42
43a	1.2	948	0.72416	-0.68963	95	5	5	1	3	3	4	0.9	38	1	4	6.34
43c	0	920	-0.88391	0.467665	18	0	83	1	3	3	3	1.2	18	1	5	17.91
44a	2.2	926	-0.71803	0.696015	95	5	5	1	4	3	3	1.4	63	1	3	7.39
45a	15.4	1146	-0.77674	0.629818	95	5	0	1	1	1	4	0.42	18	1	1	1.48
45b	1.2	1140	-0.92179	0.387698	95	5	0	2	2	2	4	0.36	18	1	1	1.98
46a	10.2	4220	-0.66667	-0.74535	95	5	0	2	4	3	2	2.2	83	2	2	39.71
47a	12.2	5506	-0.35122	0.936293	95	5	0	1	4	2	2	1.1	38	2	3	20.59
47b	6.4	5335	0.838825	0.5444	63	18	5	2	4	2	2	0.8	38	2	4	57.5
47e	1	5514	-0.87523	-0.48371	83	0	5	3	4	2	2	0.46	5	1	4	91.19
48a	22	6271	0.92827	0.371908	83	5	0	1	3	3	4	1	63	2	2	5.03
48g	25.2	6296	-0.62687	0.779126	5	95	0	1	4	3	4	0.26	5	3	2	29.94
49b	3.6	3136	0.770907	0.636947	83	5	5	2	3	2	2	0.9	63	2	4	40.39
4a	19.6	3388	0.206187	0.978513	63	38	0	2	4	3	2	2.7	38	3	1	6.93
4c	6.2	3372	-0.47917	-0.87772	38	5	63	2	3	2	2	2.6	38	2	3	8.24
4f	55.8	3496	-0.82948	0.558539	5	95	0	2	3	5	4	1	18	2	2	24.38
50a	7.6	3627	-0.03128	0.999511	95	5	0	1	2	2	2	1	83	2	3	17.33
50d	0.4	3516	-0.84841	-0.52934	38	0	63	2	2	2	1	0.8	38	1	5	38.81
51a	13	5422	0.925319	-0.37919	83	5	0	2	3	2	2	0.74	63	2	2	22.89
52a	11.8	5354	0.747757	0.663972	95	5	0	1	4	4	2	0.82	18	2	2	7
53e	1	3554	-0.65342	-0.757	95	5	5	2	3	3	2	1.4	63	1	4	60.68
54a	17.2	3592	-0.39971	-0.91664	95	5	0	1	3	2	2	0.52	18	2	3	6.5
54b	1.8	3628	-0.85796	0.51372	63	5	18	1	3	2	2	2.3	63	2	4	13.3
55a	24.4	4166	0.969371	0.245603	63	38	0	1	3	3	4	0.06	5	2	2	6
56e	2.8	3851	0.829495	-0.55851	95	0	5	1	3	3	2	1.04	38	2	4	50.25
57j	7.4	4024	-0.92859	0.371096	95	5	0	1	4	2	2	1.8	83	2	3	20.98
58b	1.2	3458	-0.62668	0.779277	63	18	18	1	3	2	2	0.6	18	3	4	17.41
59a	21	4044	-0.71773	-0.69632	63	38	0	1	3	3	3	0.56	18	2	2	8
5a	30.2	3910	-0.28398	0.95883	63	38	0	3	5	3	3	0.95	18	1	1	3.48
5c	8.8	3772	-0.49516	0.868802	38	5	38	2	4	3	3	1.4	18	1	3	10.29
5h	19	3828	0.030644	0.99953	95	5	0	2	4	2	2	2.3	63	1	2	5.45
60a	11.8	4329	0.993432	-0.11443	63	38	0	1	4	4	3	0.3	18	1	1	12
60c	5.2	4297	0.765647	-0.64326	83	5	5	1	5	2	2	0.52	5	1	4	56.72
60h	3	4287	-0.29248	0.95627	95	0	0	1	5	2	2	2.4	63	1	3	71.14
61c	9.6	3870	0.903834	-0.42788	83	5	5	1	3	2	2	0.48	5	2	3	15.92
61f	58.8	4126	-0.46351	-0.88609	5	95	0	1	4	4	4	0.12	5	1	2	10.89
62d	0.4	4022	0.723868	0.689938	83	0	18	2	5	2	2	0.84	38	2	5	56.72
63b	1.4	3239	-0.99984	-0.01797	63	18	18	2	2	2	3	0.82	18	1	4	17.33
64b	3	3093	-0.10186	0.994799	38	38	18	2	2	2	2	1	38	2	4	23.88
65f	81	2914	0.171955	-0.9851	5	95	0	2	3	4	4	1	63	1	4	10.4
65h	1.2	3200	-0.28392	0.958847	95	5	0	1	2	3	2	1.7	63	2	3	39.8
66j	8.2	5785	-0.24049	-0.97065	83	18	5	1	3	2	2	0.9	18	2	4	34.48
67d	1.2	3480	0.633552	-0.7737	63	0	38	1	3	2	1	0.2	5	1	5	77.11
68e	2.6	5514	-0.87523	-0.48371	95	0	5	3	3	2	2	0.46	18	2	4	91.19
6a	3.4	3447	-0.78204	-0.62322	63	18	0	2	4	3	1	2.4	63	2	2	6.47
6f	61.8	3601	0.741952	0.670453	5	95	0	2	4	5	4	0.8	18	3	2	15.5
6g	27	3487	0.985947	-0.16706	5	83	0	2	4	5	4	1.6	18	2	2	19
6j	5	3441	-0.57676	-0.81692	63	38	5	2	3	3	2	4.4	63	2	3	26.6
7a	15.2	4100	-0.97555	-0.21978	83	5	0	2	4	3	1	1.9	38	1	2	16
7b	6.8	4097	0.934772	0.355248	63	5	18	2	3	3	2	3.2	18	2	3	56.44
7d	5	3975	-0.63306	-0.7741	83	5	5	2	4	2	2	1.1	18	1	3	36.45
8a	23.4	2073	0.899946	-0.436	38	63	0	2	4	3	2	2.1	38	2	2	17
8b	15.6	2060	0.633459	-0.77378	38	63	18	2	4	2	3	1.1	5	1	3	24.76
8f	71	2073	0.899946	-0.436	5	83	0	2	3	4	3	0.5	5	2	2	10.84
9a	7.4	3972	0.517486	0.855692	83	5	0	2	4	2	1	1.4	38	2	2	56.16
9c	18.2	3998	-0.31774	0.948177	38	5	38	2	4	3	2	3.1	38	1	2	51.46
9f	74.8	3975	-0.63306	-0.7741	5	95	0	1	4	5	3	2	18	2	2	6.97
9g	28	3969	-0.39155	-0.92016	38	63	0	2	4	2	4	2.8	38	3	2	8.87

site	inorgan	pH_soil	dwd_cov	densio	con_cov	dec_cov	shrub_cov	herb_cov	bryo_cov	hab_het	per_occ
36e	4.52	6.93	18	67.24	63	5	18	83	63	34	76.47059
37a	0.49	4.8	18	59.92	63	5	38	63	18	28	82.14286
37j	0	6.09	18	57.9	38	5	38	63	38	24	95.83333
38a	0.99	4.65	18	85.18	83	0	5	38	18	30	80
38c	1.5	6.94	18	56.02	18	38	18	18	18	23	91.30435
39a	0.98	5.87	5	22.56	38	0	5	38	38	27	55.55556
3a	1	5.54	0	0	0	0	38	63	5	17	58.82353
3b	10.34	7.28	5	42.86	5	38	38	38	5	26	73.07692
40h	3	6.23	38	90.1	38	38	5	5	5	33	84.84848
41a	0.99	4.09	63	77.64	63	0	5	18	5	30	60
42a	1.48	6.7	18	71.98	0	63	63	38	5	30	56.66667
42c	0.99	6.49	5	19.64	0	5	5	5	5	10	40
43a	0.98	5.59	18	60.1	0	63	5	63	5	29	58.62069
43c	1.99	5.51	5	37.74	0	5	5	18	5	13	38.46154
44a	0.99	6.64	18	68	0	38	18	63	5	32	50
45a	0.49	6.42	5	0	0	0	38	38	5	9	33.33333
45b	0.99	7.88	5	0	0	5	18	63	5	10	40
46a	0.49	4.61	18	70.26	63	5	18	63	18	35	77.14286
47a	0.49	3.23	18	69.52	63	0	18	38	38	27	70.37037
47b	1	4.95	18	78.12	63	0	5	63	38	22	63.63636
47e	1.3	5.3	5	1.6	5	0	5	63	83	22	90.90909
48a	0	3.3	18	54.74	38	0	38	5	18	22	63.63636
48g	0.6	3.43	5	54.92	5	0	5	5	5	29	55.17241
49b	7.39	6.65	18	79	38	38	38	63	18	28	96.42857
4a	0.5	5.06	0	20.58	18	0	5	38	5	29	27.58621
4c	0.55	5.83	18	48.04	38	18	63	38	5	25	52
4f	1	5.8	5	33.68	18	0	18	5	18	17	58.82353
50a	0	4.53	18	61.12	63	0	63	38	18	35	71.42857
50d	4.48	7.42	5	18.36	5	5	5	83	38	22	95.45455
51a	0.5	7.15	5	69.84	63	5	38	5	5	27	51.85185
52a	0	3.7	38	3	5	0	38	38	18	26	50
53e	0.97	4.46	5	0	0	0	5	63	18	17	82.35294
54a	0.5	7.82	18	86.04	63	0	38	5	83	34	67.64706
54b	0.49	3.53	38	90.38	63	5	18	63	18	39	69.23077
55a	1	4.97	5	2.34	5	0	5	18	38	19	68.42105
56e	1.99	5.46	5	30.6	5	5	18	83	63	26	50
57j	0.49	5.5	38	76.34	63	18	18	18	18	34	85.29412
58b	1	5.77	38	79.22	63	0	5	63	63	26	80.76923
59a	1.5	7.11	5	90.48	18	0	5	38	5	38	55.26316
5a	0.5	6.43	18	7.9	5	0	5	63	5	25	32
5c	1.47	6.15	18	3.32	5	18	18	38	5	34	50
5h	0.5	7.9	18	56.36	5	83	18	18	5	24	25
60a	10.5	6.56	5	10.4	5	0	5	38	38	19	57.89474
60c	2.49	7.45	38	83.36	5	38	5	63	5	28	67.85714
60h	1.99	6.6	5	97.9	5	63	18	63	5	28	71.42857
61c	8.96	5.92	5	68.38	38	18	18	38	18	30	56.66667
61f	0.5	7.55	5	24.1	5	0	5	18	5	18	44.44444
62d	2.49	5.97	18	22.5	5	5	5	63	38	22	100
63b	0.99	6.6	18	54.72	18	38	18	38	5	30	86.66667
64b	1.49	6.6	5	92.7	63	18	5	38	38	33	72.72727
65f	6.44	6.75	5	74.94	5	18	5	18	63	19	78.94737
65h	1	7.44	38	70.48	63	38	18	18	5	32	65.625
66j	0.99	5.98	38	62.92	38	18	63	38	38	25	76
67d	3.48	5.61	18	56.32	18	18	18	83	63	23	95.65217
68e	1.3	5.3	18	90.06	18	0	5	83	83	27	81.48148
6a	0.5	6.74	18	57.18	38	5	38	18	5	30	63.33333
6f	0.5	6.24	5	23.92	18	0	18	5	18	16	68.75
6g	0.5	5.32	18	8.34	18	5	18	18	5	23	43.47826
6j	0.99	6.02	18	60.74	18	38	83	38	5	27	81.48148
7a	0	5.58	18	21.64	38	5	38	63	18	32	37.5
7b	0.5	6.21	18	32.02	18	18	38	63	38	33	63.63636
7d	0.99	5.86	5	21.22	5	18	18	63	5	27	62.96296
8a	1	5.78	5	44.92	38	0	63	63	5	22	36.36364
8b	0.97	5.97	18	52.62	5	5	83	38	18	24	79.16667
8f	0.99	6.17	0	23.5	5	0	5	5	5	16	62.5
9a	0.99	4.72	18	47.82	38	18	38	63	5	28	53.57143
9c	5.34	7.29	38	54.08	18	18	18	38	5	32	81.25
9f	0.5	5.67	5	58.44	5	5	5	5	18	20	55
9g	0.49	5.64	38	50.52	38	5	5	5	5	27	62.96296